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ABSTRACT

This document contains 14 papers from the skills for the new millennium section of an international conference on vocational education and training (VET) for lifelong learning in the information era. The following papers are included: "Research on Vocational Education and Training as a Field for Knowledge Development--Starting Points for the CEDEFOP (European Centre for the Development of Vocational Training) Research Arena" (Pekka Kamarainen); "Knowledge Development at the Interface of Research, Policy and Practice--Support for Knowledge Development within the CEDEFOP Research Arena (CEDRA)" (Graham Attwell, Alan Brown); "Use of Web-Based Collaboration and Knowledge Transformation Tools to Support the Development of a Learning Community to Enhance Career Guidance Practice" (Alan Brown, Graham Attwell, Jenny Bimrose); "Doing the Research Is Only Half the Job: The Impact of VET Research on Decision Making" (Chris Robinson, Sarah Hayman); "NCVER's (National Centre for Vocational Education Research's) Web Site and the VOCED Research Database" (Sarah Hayman); "The Renaissance of Vocational Education and Training: Miscellaneous Hints for Undernourished Elephants Yearning to Dance" (Robert Sadler); "Tele-Operation of a Manufacturing System for Vocational Education" (Francis H.F. Tsang, Jonathan K.F. Lee); "Worldwide Technology Trend of Electronics Products" (Lawrence Cheung); "The Implication of Advances in Wireless Data Communications on E-Commerce" (Lawrence Cheung);

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"New Roles of Vocational Education and Vocational Teachers for Technological Change: A Case Study of the Hong Kong Institute of Vocational Education" (Che Keung Yeung, Choi Fung Cheng); "The Occupational Skill Testing and Certification Systems in Hong Kong" (S.P. Fu); "Distance and Open Learning--Web-Based Training (WBT) Development Process Consideration" (Donna Wing Yiu Lau); and "Industry Partnership for Graduation Stage of Higher Vocational Education" (Dan-dan Shi, Xiao-hong Chen). Most papers contain substantial bibliographies. (MN)

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Paper Presentations

Session G

Skills for the New Millenium

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RESEARCH ON *VOCATIONAL EDUCATION AND TRAINING* AS A FIELD FOR KNOWLEDGE DEVELOPMENT – STARTING POINTS FOR THE *CEDEFOP RESEARCH ARENA*

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Index: Knowledge development; Research on vocational education and training; European cooperation; Communities of practice

Abstract: The paper provides an insight into the process of developing the CEDEFOP Research Arena (CEDRA) as a new kind of research-oriented knowledge resource environment. CEDEFOP is the European Union agency for development of vocational education and training (VET) in the EU Member States and in the associated countries. The main questions are:

1) How to interpret the *foundations of VET-related research* as cornerstones for knowledge development?
2) How to interpret the significance of *European* research and development *programmes* for knowledge development in the field of VET?
3) How to interpret the role of *'communities of practice'* within VET-related knowledge development?

INTRODUCTION

The following paper provides insights into starting points and into the creation of the CEDEFOP Research Arena (CEDRA). The general background for CEDRA is the repositioning of CEDEFOP (European Centre for the Development of Vocational Training) vis-à-vis European research on vocational education and training in the recent years. *Firstly*, the main issues of the repositioning are reflected from the perspective of CEDEFOP. *Secondly*, scientific foundations of and conceptual developments within research on vocational education and training (VET research) in Europe will be discussed. *Thirdly*, the role of European cooperation programmes (including transnational projects and research cooperation networks) in the creation of European VET research culture will be reflected. *Fourthly*, the development of research communities as 'communities of practice' and alongside communities of practitioners (as counterparts of researchers) will be reflected.

1. On the repositioning of CEDEFOP vis-à-vis European VET research

After the move from Berlin (Germany) to Thessaloniki (Greece) in 1995 CEDEFOP had to reconsider its position as a European agency for promoting development of vocational training. Part of this repositioning exercise was a process that gradually led to new CEDEFOP initiatives to promote European research cooperation and finally to creation of the strategic framework of CEDRA. In the following some critical issues for the repositioning are summarised. Then, some indications are given on the framework of CEDRA and how the framework tries to respond to the challenges.

The main challenges and for the repositioning of CEDEFOP in European research cooperation can be summarised in the following questions:

1) Should CEDEFOP position itself primarily as an *agency for research and development work* **or** as a *programme support agency* **or** as an external *agency for dissemination and capitalisation of outcomes*?
2) On what basis should CEDEFOP create cooperation between itself and research communities: as an *external funding body*, as a partner that provides *targeted support* for projects and networks, as a *hosting body* that has permanent support functions?
3) How should CEDEFOP emphasise in its research cooperation activities the following aspects: *monitoring* research capacities and progress in research, *promotion of* research communication and *community-building*, analysis and *capitalisation of research results*.

Following the initial repositioning debate CEDEFOP took several initiatives that led it gradually towards a more participative role in research work and profiled the role of CEDEFOP more as a partner than an external funding body or as a host. Finally, some of the initiatives have tried to develop strategic frameworks for monitoring activities, community-building measures and related capitalisation or experiences and results. In this context the plan to create the CEDEFOP Research Arena (CEDRA) paved the way for a new strategic approach. The pillars of the new strategic approach are the following:

a) the set of user-friendly information services that provide an access to information and knowledge resources (European Research Overview);
b) the thematic areas for research-oriented knowledge development (including the production of Research Resource Materials, construction of interactive Research Resource Bases, and promotion of Knowledge Sharing Networks);
c) promotion of knowledge development and research culture with general support activities such as the CEDRA Colloquium and related discussion materials.

The creation of the initial framework for the CEDRA and the related piloting is based on the learning experiences that have been made with the new activities that have been launched in the recent years. The most essential lessons for CEDEFOP and for the research communities are related to the following issues:

1) making a deeper analysis on the scientific foundations and conceptual developments within European VET research;
2) drawing conclusions from the role of transnational cooperation projects and networks for European VET research culture;
3) developing a new understanding for the role of network-based cooperation in the consolidation of research communities as 'communities of practice' *and* in the interaction between researchers and communities of practitioners.

2. On the scientific foundations of and conceptual developments within European VET research

The critical starting point for making a deeper analysis on the scientific foundations of VET research is the general position that VET research can only be seen as a ***multi-disciplinary space***. On the one hand the space is seen as a broad field that is shared by several approaches that are derived from different disciplines . On the other hand these approaches are going through processes of specialisation that link them to the field more that to the underlying structures of disciplines. In this respect the field of VET research could be perceived as multidisciplinary field that is

characterised by a basic unity. Any attempts to analyse inner differentiation within VET research could only lead to theme-based listing of VET-specific focal areas or to academic distinctions that have no relevance for the field of VET.

This general position can be challenged by a framework that takes into account the cohesive emphasis but considers it insufficient as a basis for analysing progress in research and in research-based knowledge utilisation. The framework identifies ***four kernel domains for knowledge development*** within the interdisciplinary field of VET-related research. The basic assumption is the domains of expertise are linked to different problem contexts, conceptual backgrounds, methodologies and prospects for knowledge utilisation.

In the ***socio-economic domain*** the main focus is on the need or utilisation of qualifications and competences in working life. VET is seen as a background variable and VET systems and VET provisions are seen as users of such knowledge. The research provides support for structural planning of qualification frameworks or feedback on the interrelations between VET provisions and labour market .

In the ***socio-political domain*** the main focus is on the functioning of the VET system and on the functioning of the VET provisions as parts of the system. Some lines of inquiry give conceptual support for development of VET policies. Some approaches provide feedback information that supports policy assessment

In the ***socio-educational domain*** the focus is on the educational foundations of the VET systems and VET provisions. Research in this domain covers basic analyses of the underlying educational thinking, accompaniment of curriculum processes and analyses on new modes of vocational learning and competence accumulation.

Research in the ***socio-behavioural domain*** of VET research focuses primarily on the individual behaviour of particular target groups concerning their use (or non-use) of VET provisions and concerning their behaviour at the labour market. From the methodological point there are several lines of inquiry which focus on general transition surveys, on particular studies on target groups, on accompaniment of targeted training schemes and on development of instruments that support guidance and counselling.

It is obvious that the framework - as it has been presented above – is not the whole picture of VET research. However, the framework provides a possibility to identify the kernel domains of expertise, related methodologies and related prospects for knowledge development and knowledge utilisation.

Given the differences between the kernel domains, it is possible to have a new look on the factors that promote coherence and unity within the overarching field of VET research and promote boundary-crossing dialogue and working interfaces. On the one hand these may be related to certain ***core areas for knowledge transformation*** that are characteristic for in the field of VET . As such core areas it is possible to mention the following ones:

- uses of research as a support for curriculum development,
- uses of research in the context of training of VET professionals,
- uses of research as a conceptual support for learning in organisational contexts.

In addition to these core areas it is necessary to emphasise the role of more particular *focal areas* for knowledge development that may involve only some of the domains but stimulate new alliances between VET-related research and development expertise and complementary fields of expertise. As such focal areas it is possible to mention the following:

- research on uses of information and communication technologies (ICT) in the field of VET,

- research on patterns for integrating work-related learning in VET provisions and new partnerships between educational establishments and work organisations,
- research on regional VET-related initiatives and on their links to broader regional initiatives.

3. On the role of European programmes for the development of research culture

It is essential to note that the field of VET research is to a major extent overshadowed by the national characteristics of VET systems. Therefore, national concepts and underlying assumptions provide conceptual barriers to cross-cultural communication and for knowledge development at European level. From this perspective it is necessary to have a closer look what kind of role of transnational research cooperation may have in knowledge development in the field of VET.

Roughly, the impact of European cooperation programmes on European research culture can be indicated in the following points:

1) development of a new kinds of transnational projects that do not limit themselves to pre-comparative reporting on national developments *but* proceed to problem-oriented comparisons and to treatment of critical issues with patterns of collaborative research;
2) development of new kinds of networks that do not limit themselves to mere exchange of information and joint tenders *but* develop themselves as working and learning communities;
3) development of new kinds of joint communication facilities for supporting knowledge sharing among research communities and for promoting further analysis and utilisation of research in an organised dialogue between researchers and users of knowledge.

In this context it is necessary to note that transnational projects have raised new needs for 'accompanying research' or 'research-oriented monitoring' or 'research-based capitalisation of the outcomes' at the European level. At the same time transnational cooperation has opened new possibilities for knowledge transfer between different national patterns.

In general terms the notion *'accompanying research'* refers to a programme context in which reform activities, experimental programmes or innovatory initiatives are supported by a related research project. The notion 'accompanying research' refers often to single projects and individual case studies. Consequently, the notion *'research-based accompaniment'* is a more generalised expression which characterises the role of accompanying research projects in the programme or accompanying measures that cover a broader range of innovatory activities. In many countries there is no systematic pattern of to link such research-based support to pilot projects. However, most European countries have experience on similar uses of research in VET-related development concepts, but in slightly different roles (such as 'evaluation research', 'implementation research', 'process consultancy' 'action research').

The current interest on such research approaches is related to efforts to create a more systematic understanding of research as an infrastructural and interactive element in supporting the development of VET systems and VET provisions. This interest is closely related to the interest to consolidate VET research as a 'practice' *and* as 'research' that has a particular intermediate function between theory and practice.

4. On the role of scientific communities and of 'communities of practice'

The issues that have been discussed above tend to fall beyond the scope of traditional research disciplines. At the same time there are very few examples of countries that would have provided VET research the basis to develop particular research disciplines. Instead, the typical problem in

most European countries is that of VET research suffers from an institutional marginalisation. To some extent this marginalisation has been overcome by the community-building initiatives of transnational research cooperation networks.

As a part of its efforts to promote European research cooperation CEDEFOP has tried to develop an appropriate approach to support the community-building measures that are based on 'independent' networks. Moreover, CEDEFOP has tried to find out whether there is a possibility to develop synergy between major networks that have complementary tasks.

However, because of their voluntary and temporary character networks have only a limited potential to promote the consolidation of research communities within European VET research. Instead of being infrastructural actors they should be considered as particular platforms that contribute to community-building processes.

Therefore, CEDEFOP has shifted the emphasis from 'networking the networks' to 'networking of knowledge resources' and to support for knowledge development that draws upon the work of European cooperation projects and networks. Moreover, CEDEFOP has to take into consideration the limits of research communities as actors in knowledge development *and* potential conflicts of interest between research communities and communities of practitioners. In this respect CEDEFOP has to emphasise the needs of balanced *research dialogue* between knowledge production and knowledge utilisation. The theoretical insights into the scientific foundations of VET research and into the development of research culture provide a basis for positioning CEDEFOP as a promoter of European research dialogue.

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KNOWLEDGE DEVELOPMENT AT THE INTERFACE OF RESEARCH, POLICY AND PRACTICE – SUPPORT FOR KNOWLEDGE DEVELOPMENT WITHIN THE CEDEFOP RESEARCH ARENA (CEDRA)

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Index: Computer-mediated collaboration; technology; knowledge development.

Abstract: This paper outlines the underpinning theory and technology supporting processes of knowledge development within the CEDEFOP Research Arena (CEDRA). The support for dispersed communities of practice has been developed using web-based collaboration and knowledge sharing tools. These provide a comprehensive telematic platform for interactive and focused knowledge sharing and transformation for practitioners, policy makers, and researchers interested in vocational education and training in Europe. Note some details of how these tools work in practice, in the context of careers guidance, is given in the linked paper of Brown and Attwell (2000).

INTRODUCTION

Previously Brown & Attwell (1999) produced an overview of how computer-mediated collaboration and knowledge transformation processes can support a community of practice of Vocational Education and Training Researchers in Europe. The first task here is to focus upon how the theoretical framework developed to explain processes of organisational knowledge creation (Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998) was adapted to provide a theoretical underpinning for the design of the CEDEFOP Research Arena (CEDRA). For the CEDRA telematic platform we are using a social model of knowledge creation, and the key process for genuine knowledge transformation to occur is that knowledge has to move from the individual level into wider communities of interaction that cross organisational boundaries. Nonaka & Konno (1998) use the idea of *ba* as shared spaces for emerging relationships that provide a platform for advancing individual and/or collective knowledge and of generating collaborative processes that enable the transformation of that knowledge to other contexts. In this framework if knowledge is separated from *ba* – space for interaction and relationships – it becomes merely information.

Information can reside in networks through associated papers, but knowledge resides in the relationships of the *ba*, because it allows possibilities for collaboration to transcend particular perspectives. In the field of vocational education and training, for example, information on the use of key qualifications in practice remains underused in practice precisely because it remains as information – few opportunities are given for practitioners to transform this into practical individual and collective knowledge. Within a telematic environment it is possible to get contributions from a

range of perspectives. It has great potential, although in many computer-mediated communication (CMC) environments that potential is not always realised. This may be because the analytically rational world of 'pure' CMC environments may be too 'cold' for many people: they need a richer form of engagement. Nonaka & Takeuchi's (1995) SECI model (of socialisation, externalisation, combination and internalisation) as a spiral of dynamic knowledge conversions gives insight into why this lack of engagement may occur (see figure 1).

Figure 1: Adaptation of Nonaka & Konno's (1998) four Characterisation of Ba

Socialisation Originating Ba (Space for socialisation: face to face interactions)	Externalisation Interacting Ba (Space for active reflection)
Internalisation Exercising Ba (Space for conversion of explicit knowledge to tacit knowledge of individuals and groups)	Combination Cyber Ba (Space for combining new forms of knowledge with existing information)

Note: Continuous spirals occur through SECI process.

Nonaka & Konno (1998) point to the need for an originating *ba* (or space for socialisation) where individuals can share feelings, emotions, experiences and mental models. This is necessary not only to generate initial commitment (the value of which has long been recognised), but also because genuine knowledge transformation also requires a "magic synthesis" of rationality and intuition that requires a greater depth of human engagement than just thinking. Their model is implemented within CEDRA in the following way:

Socialisation (through originating *ba*):

A number of meetings have been held in different parts of Europe in order to allow some of those involved in a dispersed community of practice to understand the principles behind the development of CEDRA and to discuss some of the substantive issues highlighted in the different Research Resource Bases.

Externalisation (through interacting *ba*):

This will involve the set up of thematic groups, comprising individuals with a mix of backgrounds, knowledge and capabilities. Individuals will then be able to share their own models, ideas and understandings, and through processes of reflection and analysis, seek to generate some common understandings of the group's particular themes. Through focused interaction tacit knowledge could be made explicit and some new understandings of 'knowledge' created, upon themes such as learning organisations, continuing professional development in VET, and key qualifications.

Combination (through cyber *ba*)

Each group's ideas (and explicit knowledge) are then presented in the telematic environment, where their ideas are combined with existing information and knowledge drawn from the rich evidence environment in a process of knowledge transformation. Other members of the learning community will be encouraged to contribute to and engage with this process.

Internalisation (through exercising *ba*)

The exercising *ba* is a shared space in the telematic environment to facilitate the conversion of the (newly generated) explicit knowledge into the tacit knowledge of individuals and groups. This will involve active consideration of how to apply that knowledge in different contexts and the use of strategies to support the knowledge conversion process. An example of this would be through consideration of how particular cases could be adapted in order to be applied in other settings.

CEDRA will facilitate the spiralling of knowledge creation and transformation through continuing SECI cycles on different themes. The dynamic structure of the telematic environment will also allow material and ideas to be rapidly transferred between themes. The essence of the *ba* of the learning community as a whole is that it will not involve a static accumulation of different materials, documents and information, but rather it will possess the dynamism to continually create new knowledge. Within this vision the role of the telematic platform of CEDRA is to provide a rich virtual knowledge environment to support the processes of collaboration and knowledge creation and transformation in European VET research and development.

SUPPORTING KNOWLEDGE DEVELOPMENT THROUGH CEDRA

CEDRA does not focus simply upon computer mediated communication. It seeks to enhance and facilitate processes of knowledge development within the wider community of practice. CEDRA will continue with meetings and seminars, and will support dissemination through more traditional print media as well as developing CMC and ICT based systems and processes. CEDRA emphasises too the importance of developing spaces for the exchange of information, and establishes links or gateways to other sources of information, including material from a variety of organisations with an interest in policy, practice, training or research in vocational education and training.

The material to be presented in CEDRA telematic platform is being converted into structured XML resources using a specially designed editor. The aims of this conversion are to allow additional layers of meaning to be added to documents and other materials, in order to enable discussion and knowledge transformation processes based on the materials to occur at a fine grained level and to make meanings more explicit. We do not intend that 'documents' should apply simply to written papers. Given that one of the key aims of CEDRA is to develop knowledge through sharing of ideas and meanings, we believe that there is the need to exchange and co-operatively create a wide range of materials. The materials we are using include edited transcripts of practitioner testimony, group discussions on key issues, and case studies of problems found in practice. Where we are working with research or policy 'papers' or 'documents' we seek to break these down into smaller components (or 'chunks') that contain key ideas or meanings. A component may, for example, express a hypothesis, advance a concept, contradict other findings, illustrate a key point or advance new thinking.

The editor also allows authors to construct and develop new relations between ideas contained in text, or to external papers and work. The richer format of description is added through a document type definition – or 'schema' - that can be defined for each 'kind' of resource. Different schemas might include a case study, an evaluation report, a portfolio or a comparison. The editor uses eXtended Markup Language (XML) code. This is a flexible language, designed to allow open standards to be defined by communities of practice themselves, and to allow interchange through the World Wide Web. Unlike the standard Hypertext Mark-up Language (HTML) used by most Web sites, XML allows software to 'know about' the content of a document as well as its appearance and layout. The XML representation of the resources can be rendered in different ways

to allow different ways of 'viewing' content and interacting with it. The first render being developed provides a Web interface. Whilst documents may be viewed in a traditional way, different navigation options allow the user to access smaller components and to reorganise views of parts or the whole resource base. This will be of particular value as the resources grow. Key-word searches and scrolling of documents at the moment allow only limited access to ideas, compared to the much wider range of ways of searching and representing material afforded by our navigational tools.

Another key feature is the ability to access other texts thorough embedded icons and roll over items. This may for instance provide information on the background to a reference, or details of a glossary item or details of a linked idea or access to a footnote. Most powerful is the ability to access and add annotation to the text, and to annotate the annotation. Instead of having a separate list server or email client for discussions about an idea or case study the discourse can be embedded in the document itself. Going one step further, it may be that the discourse emerges around the annotation and that then becomes a major document in its own right. A record of the discourse is readily available as part of the site itself. There is no need for participants to join a formal group or painstakingly try to keep up to date with lengthy communications.

In its focus on discourse though shared annotation as a major means of communication, CEDRA is building on older academic practices of knowledge development. Documents cease to be statically presented but take on a 'social life' through a process of interpretation and disputation. The process of knowledge transformation may be particularly potent in an interdisciplinary field such as careers guidance. Knowledge may be transformed through a process of re-contextualisation to different settings and boundary crossing between different academic traditions. The fine-grained semantics that the editing tools seek to supply should facilitate these processes. A focus on practice is a central theme of CEDRA, in order to encourage the development of knowledge, that makes use of the processes of '*knowing*' that Brown and Duguid (1996) see as crucial in the development of new knowledge. The key problem unmasked by the attempt at extensive computer-mediated collaboration by teacher training institutions across Europe in the REM project (Owen and Liber, 1998) is how to facilitate discourse and interaction. Unfortunately, most university or project web sites centre on disseminating the outcomes of research rather than on facilitating debate about practice.

How can this focus on practice be developed? CEDRA will attempt to link with students, trainers, practitioners and policy makers as well as researchers. Encouragement will be given to making links to practice, especially through links with research and development projects. Acts of reflection performed during development can be more important than the products of the work for developing knowledge from practice. The provision of a good user interface is critical. At least in its early developmental or experimental phase, CEDRA will draw upon face to face discussions and events to tie into a series of 'events' using virtual technologies. These could take the form of on-line seminars or debates. The key criteria are that they are well prepared, time bound and moderated. Whilst the use of the tools outlined here might mark a first step, further investigation is needed into the design of interfaces for Continuing Professional Development for dispersed communities of practice. At the same time as developing CEDRA as a focus for knowledge sharing and development, it is important to study its use and to continue explorations and research into the broader processes of knowledge development in communities of practice. The evaluation of the use of collaborative technologies in supporting communities of practice is vital if lessons learned on this project are to generalised. There has been considerable interest in the role of technology in the support of collaborative and communicative work and learning. These have been seen, for instance, in the context of work flows (Winograd & Flores, 1987), as collaborators around living documents (Brown & Duguid, 1996) or as socio-cultural activity systems (Engeström & Cole, 1993). These ideas have been applied to education (for example, Guile & Hayton, 1999), where they have

generated both strong opposition (Robbins & Webster, 1999) and major supporters for the use of collaborating technologies as learning tools (Mason, 1998). In general, however, practice has not always lived up to the potential (Hilz, 1985), so critical scrutiny formatively and summatively is vital in considering the degree of success of the innovative use of telematic tools proposed in this project.

Perkins and Newman (1996) point out that while there are often virtuosos in such milieux, there are also those who are only there by virtue of registration and not by their engagement. The issue of what is and what is not effective for some in these on-line collaborative situations needs to be addressed if we are to develop some generalisation of the processes of the use of technology in the support of communities of practice. We will therefore evaluate the processes of collaboration and learning supported by the technology. We will study the community of practice in its socio-cultural setting to uncover some of the reasons, issues and problems that make the use of these technologies successful or unsuccessful. This is intended to be a formative and iterative approach as the management of the system will change in reaction to the evaluation. We will adapt methodologies of systems design that are firmly based on socio-cultural activity theory (Engestrom and Cole, 1993). Kapetelinen and Nardi (1997) have produced guidance that will be incorporated into the evaluation approach.

Kaptelinen and Nardi's checklist, for the application of activity theory to human computer systems design, is a conceptual tool for identifying the most important factors influencing the use of computer technologies in a particular setting. The process from their perspective follows a clear sequence. The first phase involves starting from observational data to indicate potential problems, then formulating requests for further analysis, and providing some suggestions on how the "problem" can be solved. In the second phase an Activity Checklist, that can be used iteratively, is introduced. The general structure of the Checklist corresponds to the four main perspectives on the use of the technology to be evaluated:

- focus on the structure of the user's activities - that is the extent to which the technology facilitates and constrains attaining the user's goals and the impact of the technology on provoking or resolving conflicts between different goals;
- focus on the structure of environment - that is the integration of technology to support a community of practice with requirements, tools, resources, and social norms of the environment;
- focus on the structure and dynamics of interaction - that is internal vs. external components of activity and support of their mutual transformations with the use of systems to support and build communities of practice;
- focus on development - that is the developmental transformation of all the above components as a whole.

CONCLUSION

The knowledge transformation activities of CEDRA will involve a mix of real and virtual encounters, leading to a spiral of knowledge creation and transformation on different themes. The dynamic structure of the telematic environment will also allow material and ideas to be rapidly transferred between themes. The essence of CEDRA is that it will not involve a static accumulation of different materials, but rather it will possess the dynamism to continually create new knowledge. Within this vision the role of the telematic platform is to provide a rich virtual knowledge environment to support the processes of collaboration and knowledge creation and transformation to support research and development of vocational education and training in Europe.

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USE OF WEB-BASED COLLABORATION AND KNOWLEDGE TRANSFORMATION TOOLS TO SUPPORT THE DEVELOPMENT OF A LEARNING COMMUNITY TO ENHANCE CAREERS GUIDANCE PRACTICE

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Index: Careers guidance; information technology; knowledge transformation.

Abstract: This paper outlines progress towards the development of a learning community to enhance careers guidance practice, through the process of developing web-based collaboration and knowledge sharing tools. These will be used in order to provide a comprehensive telematic platform for interactive and focused knowledge sharing and transformation for Careers Guidance students, tutors, practitioners, policy makers, and training organisations as collaborative participants in a dynamic community of practice. Note some of the technical detail of the operation of the system is given in the linked paper of Attwell and Brown (2000) describing knowledge development in the CEDEFOP Research Arena.

INTRODUCTION

One aim of a major European-funded ADAPT project is to seek to support the development of a learning community to enhance careers guidance practice as a key service to education and training in the United Kingdom. The focus upon enhancing careers guidance practice is particularly apposite at this time because the massive and continuing changes in policy and practice in this area have left policy-makers, practitioners, trainers, students and researchers without a coherent view of how careers guidance will develop in the medium term. This presents an excellent opportunity to engage all players in a search for new understandings of the contextualisation, enrichment and renewal of Careers Guidance as a key service to education and training. A second reason for focusing upon the development of a learning community based upon careers guidance practice is because the training of careers guidance practitioners is also being extensively reshaped. This has profound implications for initial training and continuing professional development (CPD) programmes. The processes of teaching, learning, knowledge development and utilisation will all need to be reshaped. The project is working with training providers in England, Scotland and Wales to develop an imaginative way of linking processes of knowledge acquisition, development, transformation and creation with approaches to tackling the core problems of Careers Guidance practice.

The different groups mentioned above sometimes interact at conferences, seminars or carers guidance 'fairs'. However, the Careers Research Network established under the ADAPT project is the first attempt to bring together all parties with an interest in research and development of careers guidance practice. This bringing together of representatives of a dispersed community of practice has proved very worthwhile, but something in addition to face to face meetings is required to turn this into a more inclusive learning community. The ADAPT project is in the process of developing prototype web-based collaboration and knowledge sharing tools to support the network. The intention is to provide a comprehensive telematic platform (or Guidance Arena) for interactive and focused knowledge sharing and transformation for Careers Guidance students, tutors, practitioners, policy makers, and training organisations as collaborative participants in a dynamic community of practice.

THEORETICAL FRAMEWORK

The project is dependent upon the integration of ideas from three strands of previous research. First, when seeking to develop a learning community to enhance careers guidance practice we believe the relevant unit of analysis is careers guidance practice within particular social, cultural, historic and political contexts. This fits with Engeström and Cole's (1993) notions of cultural historic activity theory. Second, our view of how knowledge creation and transformation processes, grounded in practice, can be facilitated is developed from the work of Nonaka and Takeuchi (1995) and Nonaka & Konno (1998). Third, the investigation of the pedagogical aspects of the innovative use of telematic tools to support a professional community of practice will draw upon Kaptelinen and Nardi's (1997) activity methodology as the basis for the enquiry.

The design of technological support for the development of communities of practice calls for the use of highly innovative design methodologies that take into account the social, cultural, historic and political context that any change is to be located (Engeström and Cole, 1993 : see figure 1).

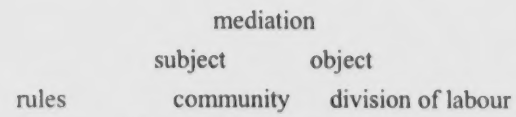

Figure 1: activity system

note i: each factor is influenced by each adjacent factor irrespective of level

note ii: the whole system is dynamic and changes over time

Applying Engeström and Cole's (1993) activity theory framework to our study of careers guidance practice would give the following:

- Subject: careers guidance practitioners (goal-directed actions; beliefs; ideas; mental models);
- Object: careers guidance practice (patterns of behaviour; relations with clients);
- Mediation: socio-cultural ideas about guidance practice (tools; theories; approaches; historical traces and cultural meanings associated with careers, occupations and identities);
- Rules: changing frameworks for regulation of practice (focus of guidance practice; statutory entitlements; service targets);
- Community: extent to which value systems are shared (ideas about 'good practice', meeting targets, nature of professionalism);

- Division of labour: between practitioners, specialists and assistants (roles and relationships).

The 'value added' of applying cultural historic activity theory to the enhancement of careers guidance practice is that it gives a much richer framework for searching for new understandings of the attempts at the contextualisation, enrichment and renewal of careers guidance. It can be used to highlight the value of analysis of the consequent effects elsewhere in the system of changes in one part of the system. In particular, this framework can help participants and researchers in the learning network to generate questions for discussion. For example, what value do practitioners place upon innovative practice? Such questions can help ensure that the complexity and inter-relationships between issues are addressed when considering the renewal of careers guidance as a key service to education and training.

For the second key strand Brown & Attwell (1999) have produced an overview of how computer-mediated collaboration and knowledge transformation processes can support a community of practice (in that case of Vocational Education and Training Researchers in Europe). How we draw upon the theoretical framework developed to explain processes of organisational knowledge creation (Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998) to provide an additional theoretical underpinning for our project is outlined in the linked paper of Attwell and Brown (2000) describing knowledge development in the CEDEFOP Research Arena. In this case knowledge transformation for a learning community to enhance careers guidance practice will involve a mix of real and virtual encounters. We are using a social model of knowledge creation, and the key process for genuine knowledge transformation to occur is that knowledge has to move from the individual level into wider communities of interaction that cross organisational boundaries.

The project will involve the spiralling of knowledge creation and transformation through and across different themes. The dynamic structure of the telematic environment will also allow material and ideas to be rapidly transferred between themes. That is, it will not involve a static accumulation of different materials, documents and information, but rather it will possess the dynamism to continually create new knowledge. Within this vision the role of the telematic platform (Guidance Arena) is to provide a rich virtual knowledge environment to support the processes of collaboration and knowledge creation and transformation in the learning community developed to enhance careers guidance practice as a key service to education and training.

INNOVATIVE USE OF TELEMATIC TOOLS TO SUPPORT A PROFESSIONAL COMMUNITY OF PRACTICE

We are attempting to align pedagogic processes and a web-based knowledge environment to support the processes that lead to the development and use of new knowledge in an innovative way. But for this to happen we need a deeper understanding of the ways in which individuals and communities of practice communicate and the ways in which communication leads to knowledge development. Professional knowledge can itself regarded as a personal synthesis of received occupational knowledge and situational understandings, derived from experimental learning, which are capable of being further transformed through a process of critical reflection. As expertise develops, and new contexts are utilised in the performance of practice, so the processes of research, review and reflection can lead to the creation of new forms of knowledge (Engeström, 1995). Continuing professional development can play a role in making these processes explicit such that others too can share in the developmental process. We will study the community of practice in its socio-cultural setting to uncover some of the reasons, issues and problems that make the use of these technologies successful or unsuccessful. This is intended to be a formative and iterative

approach as the management of the system will change in reaction to the evaluation. We will adapt methodologies of systems design that are firmly based on socio-cultural activity theory (Engeström and Cole, 1993). Kapetelinen and Nardi (1997) have produced guidance that will be incorporated into the evaluation approach. As well as a commitment to the practical utility of the system being developed, we also intend to investigate some broader research questions. These questions include:

- is it possible to develop and sustain a learning community to enhance careers guidance practice as a key service to education and training;
- is it possible to provide a comprehensive telematic platform for collaboration, including interactive and focused knowledge sharing and transformation for the Careers Guidance community of practice;
- what are the pedagogical aspects of the innovative use of telematic tools to support a professional community of practice that influence how a learning community develops?

The basic infrastructure of the telematic platform is more fully described the linked paper of Attwell and Brown (2000) describing knowledge development in the CEDEFOP Research Arena. A simple Web authoring interface has been developed that will allow users to render and annotate documents. This means all users will be able to produce structured documents. The prototype communication and knowledge transformation tools have been produced through intensive collaboration with practitioners. The knowledge transformation tools allow for the contextualisation, 'tailoring' and enrichment of research results through further processes of knowledge transformation and creation. Further technical development, refinement, monitoring and reviews of electronic architecture (including the tools for knowledge transformation and collaboration) will occur throughout the lifetime of the project.

MATERIALS PRODUCTION IN THE KNOWLEDGE CREATION PROCESS

The telematic platform for interactive and focused knowledge sharing and transformation involves eleven central strands. All material will be coded in XML, allowing for varying representations of material drawn from the different strands (Attwell & Brown, 2000). The strands will not remain as discrete areas rather material will be dynamically created on a thematic basis. The eleven strands are:

Introduction to the site:

material relating to the purpose of the site; aims, objectives and project description; invitation to collaboration; opportunity for general comments

Material from direct practitioner experience:

this could relate to identification of core problems of guidance practice; 'good practice'; project work; critical reflection upon experience; implementation of special programmes; use of 'tailored' tools; evaluating practice; how the new system of personal advisors is operating in practice

Material relating to policy development and implementation:

key elements of policies; commentary, analysis and discussion; range of stakeholder perspectives; development of evidence-based policy; policy and programme evaluation; development and implementation of the new Connexions Service

Reference material:

labour market information, analysis, forecasts and intelligence; skills observatory; education, training and employment pathways

Research material:

on guidance practice (interviewing; group-work; ethics) and related issues (social exclusion; refugees; labour market transitions; identity formation processes; completion rates in education and training; equal opportunities). Research findings will be drawn from pure and applied research. Practitioner research will be particularly encouraged.

Training material:

changing contexts and curricula for training; training exercises; video material on interviewing; 'good practice' exemplars; moderated discussions; assignments

Tools:

supporting the development, testing and evaluation of tools and materials for use in careers guidance

Signposting material:

reference to other sites and sources of information

Student material:

project work; assignments; sharing of experiences; developing expertise

Evidence of continuing professional development:

evidence of reflection upon practice; professional model of regular supervisory practice; portfolio creation

Evaluation material:

responses to use of telematic tools and environment; links to practice; critical reflection; dynamics of interaction; continuing feedback

COLLABORATIVE ENVIRONMENT

The environment has to be used interactively and collaboratively if it is to be a genuine shared space for knowledge transformation. The interactivity within the rich evidence environment comes from the ability to:

- (jointly) develop, edit and modify materials;
- share annotation on material (annotation will be available alongside the material, not simply as a 'thread' as with existing CMC systems);
- facilitate the sharing of experience;
- promote discussion, sharing and active collaboration;
- offer virtual (and real) spaces for debate and collaboration;
- support action research;
- offer active support and moderation;
- offer support to particular interest groups (e.g. managers; those assembling evidence of continuing professional development; students etc.);
- contribute to a forum for discussion of attempts to tackle complex problems in authentic contexts.

CONCLUSION

The process of building a Guidance Arena comprising a rich knowledge environment (accessible to all through the web), that uses telematic tools for collaboration and knowledge development, is still in the early stages of development. The intention is that this should act as an essential support for establishing a learning community of careers guidance. We are interested in extending our collaboration, and we would particularly welcome the involvement of those who are interested in the substantive issues of careers guidance practice or in how to offer virtual support to dispersed communities of practice.

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DOING THE RESEARCH IS ONLY HALF THE JOB: THE IMPACT OF VET RESEARCH ON DECISION-MAKING

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Index: Vocational education and training; Educational research; Information dissemination; Research utilisation; Policy development; Decision making

Abstract: In this paper the proposition that vocational education research ought to have a greater impact on theory and practice is explored. The development of a new approach in Australia is outlined. This approach is based on three key elements. First, was a deliberate strategy over the past decade to increase the amount of research being undertaken. Second were steps taken to improve the relevance of that research to policy development and decision making processes. Third is a variety of ways now being instigated to ensure the utilisation of that research by various stakeholders in the vocational education and training sector. The key message is that doing research is only half the job.

INTRODUCTION

During the 1990s a new theme began to emerge in the international literature about education research, including vocational education research. That theme concerned the notion that such research ought to impact on decision making and policy in a more substantial way than had occurred in the past. Bengtsson (1997) described such a trend in the work of the Organisation for Economic Corporation and Development (OECD), and OECD (1995), Hegarty (1999) and Rokika (1999) document examples from a wide variety of countries around the world about the greater utilisation of education research in decision making.

Despite these developments, it is clear that too often policy and decision making processes remain quite separate from research processes. Major decisions are taken without any direct reference to research. Much research remains 'researcher or curiosity driven' with no direct relevance to the policy relevant issues, let alone being part of the policy process.

In this paper, we explore some major developments in vocational education and training (VET) that have occurred in Australia in recent years to try to ensure that VET research plays a much more direct role in policy and decision making.

INCREASING THE AMOUNT OF VET RESEARCH UNDERTAKEN

Research in VET in Australia has grown rapidly in the past decade. Significant programs of research, statistical collection and analysis are under way. Research in this area is undertaken within key research centres, in universities, in VET institutions and within State and Territory training

authorities. The National Centre for Vocational Education Research (NCVER) is a national publicly funded agency which oversees and co-ordinates much of this research, as well as undertaking its own in-house program of research. NCVER also manages national surveys and collects national VET statistics.

However, Australia entered the 1990's with a very small VET research base. There was a paucity of VET research, apart from the modest program of research carried out at that time by the National Centre for Vocational Education Research. A number of commentators pointed to a lack of VET research in comparison with other sectors (McDonald et al 1993, Ramsay 1993, Butterworth 1994). Even more pertinent were the findings that this lack of VET research meant that research was a much lower than optimal influence on the formulation of VET policy and practice in Australia (Hall 1993, McDonald et al 1993, Wiltshire 1993, Robinson and Thomson 1998b). This history has been extensively documented in Selby Smith et al (1998).

The vastly improved contemporary effort in Australian VET research began with McDonald et al (1993) in the release of a key report on the state of Australian VET research called *No small change*. This report contained proposals for a national VET research and development strategy. Subsequently the Australian National training Authority (ANTA) established The ANTA Research Advisory Council (ANTARAC) in 1994 to increase the volume, scope and coverage of VET research. This led to a substantial increase in the funding and coverage of Australian VET research. These developments are described in Hawke and McDonald (1999). This included the growth of new research centres in addition to the NCVER so that some 20 centres undertaking VET research were operating by 1996.

Arrangements for the management of VET research in Australia were further reformed in 1996 with the rationalisation of the then separate NCVER and ANTARAC activities under the one set of national VET research arrangements that are managed by the NCVER (see Robinson 1997, Robinson and Guthrie 1998).

Central to this consolidated approach to VET research was the development of a unique national policy in 1997. This policy – *The national research and evaluation strategy for vocational education and training in Australia 1997-2000* – set the parameters for a concerted national approach to VET research in Australia. The policy was published in 1997 (NCVER 1997). The key elements of the policy are described in Robinson (1997). Almost 100 new research projects were commenced or completed in the first two years of the policy (see Robinson and Guthrie 1998), an effort which has continued since.

McGaw (1999) recently examined the impact of two major early 1990s reviews of education research in Australia. He concluded that the *No small change* review (McDonald et al 1993) had had a very major impact on changing the scope and quantity of VET research in Australia, whereas the other reviews of education research more generally had not (McGaw et al 1992). The key difference (according to McGaw 1999) is that action to initially act on review findings fell to a single agency – the Australian National Training Authority – in the case of VET research, whereas for education research more generally concerted action would have been required from a complex plethora of education agencies and institutions, and this did not materialise.

The nature of Australian VET research over the 1990s is examined in Robinson and Thomson (1998b), Robinson and Guthrie (1998) and Stevenson (2000).

INCREASING THE RELEVANCE OF VET RESEARCH

Australia's national VET research policy – *The national research and evaluation strategy for VET 1997-2000* – was based on two key elements designed to improve the relevance of research to policy and practice in the VET sector, which were:

- to hold widespread consultations with the key stakeholders/potential users of VET research to shift the emphasis away from 'researcher driven' research to ensure research priorities reflect VET stakeholder needs and requirements
- to base the research priorities on the national objectives for VET identified in Australia's national VET policy—'*A bridge to the future: Australia's National Strategy for Vocational Education and Training 1998-2003*' (see ANTA 1998).

This process culminated in six key research priorities being identified in Australia's national research policy, these being research into:

- the economic and social implications for VET
- employment and workforce changes and the implications for VET
- pathways from school to work
- the outcomes of VET
- the quality of VET provision
- future issues affecting the VET sector.

INCREASING THE UTILISATION OF VET RESEARCH

In recent years NCVER has published a couple of extensive and academically thorough reports on the impact of VET research on policy These were *The impact of research on VET decision-making* (Selby Smith et al, 1998) and *The impact of R&D on VET decision-making: A range of case studies* (Selby Smith 1999). Essentially this work found that the key impact of VET research in the past has been indirect, with research results feeding into the 'conventional wisdom' about issues, rather than directly impacting on particular decisions. Very often key decision-makers are using research results without being aware they are doing so.

Selby Smith et al (1998 p.21) found that 'The research enterprise is accumulative. Much research does not stand on its own as a piece of work, but adds to what existed before. This accumulated body of knowledge contributes in decision making to the creation of a climate of opinion and the development of a set of ideas, so that at any given time certain ideas, approaches or ways of thinking are in "good currency" while others are not.'

While this is useful, it is clear that if a concerted effort is made to make research and statistical analysis much more relevant to the contemporary needs of policy-makers, enterprises, VET authorities, VET providers and other stakeholders, then a much bigger and more direct impact from all this work can and does arise. A marketing study commissioned by NCVER (Figgis 1998) suggested the key is to alert people to the fact that there is a research story and then tell the research story properly.

In response to these notions the NCVER is now putting as much effort into developing new ways to promote research usage, as it does into doing the actual research. Over the last few years, NCVER

has been focusing increasing amounts of its attention and resources on ensuring that what it does, and manages, is produced and disseminated in forms which are useful to those in the sector.

A number of different approaches have been developed. These are described in more detail in Robinson (1999a) and include—

Core publications: Firstly, there is still a need for publications of the primary research findings information including research reports, journals and journal articles and conference papers. There is also a place for the main statistical publications derived from the national data collections and surveys. NCVER published more than 100 reports in the past year, as well as a scholarly journal (*Australian and New Zealand journal of vocational education research*) and a magazine (the *Australian training review*). Attention has been paid to producing better written and better focused executive summaries of these publications, and workshops have been run for Australian VET researchers to develop their skills in this area. However, it needs to be recognised that these primary reports tend to reach the research community rather than other stakeholders such as practitioners and policymakers. Therefore, other approaches have been taken in tandem with the publications.

Going digital: NCVER has made significant improvements over the past year to its web site and this will increasingly be the main platform used for its delivery of VET research and statistical information. New features on the web site include: research and statistical sections, summary pages for each research project, current news and events, downloadable publications, a greater number of full-text electronic publications, e-mail contacts for key staff, sophisticated auto-linking between related documents on the site using metadata, online project tender information, online registration for conferences and forums.

VOCED database: The Vocational Education and Training Research Database (VOCED) has been significantly upgraded over the past year to become a truly international research tool, providing information about VET research, policy and practice gathered from a wide range of Australian and international sources. This database has been made freely available on NCVER's web site, and is thus readily accessible to all stakeholders in the sector. This will be the subject of a presentation at the second part of this workshop.

Media: It is vital to make sure that key and current VET issues are mentioned in the media, both the specialised education media and where appropriate the mainstream media. NCVER has embarked on a more strategic program of placing research results in the various media to ensure that the outcomes of research are known about and thus do become part of the conventional wisdom.

Value added products: NCVER has begun to publish new types of research publications which are specifically designed for policymakers and others who do not need or wish to read long reports. They are known as 'at-a-glance' publications and draw together key points on a particular topic that emerge from the research findings and the statistical data we have gathered. They report on the key research results that emerge from a body of recent research work (rather than on the results of a single new research study) about a topical issue. The research studies covered include new NCVER research *and* any other relevant research. These have been very well received, as they offer an easy to read analysis of key information on issues of current relevance.

Getting the message out face to face: NCVER has continued its program of conferences, workshops and seminars, but has targeted these at specialised audiences in preference to hosting a large diffuse conference as was the practice in the past. In particular, workshops and forums have been held in capital cities across the country to provide direct information about research and trends in key areas to the people who work in VET and the people who make decisions in VET. The most important new development, however, has been the deliberate targeting of a new audience for research results – that being senior policy makers and advisors. Thus the NCVER has run face-to-face briefing sessions with senior government officials, training bodies and training authorities, employer organisations and union leaders about key developments and new research findings.

CONTRIBUTING DIRECTLY TO POLICY DEVELOPMENT

Better use of the research effort is a very useful exercise, but getting research to be an integral part of the policy development process is an even more potent way of ensuring that research can have a real impact on shaping VET policy. This theme was explored by Bengtsson (1997 p.167) who argued that the report '*Education research and development: trends, issues and challenges* (OECD,1995) makes it clear that the linear model between the education researcher and the policy maker is on its way out and is being replaced by a much more interactive model in which three sets of stakeholders work together: researchers, practitioners and policy makers'.

An example of how the NCVER has been developing this approach in Australia in relation to research and policy development of Australia's apprenticeship and traineeship system is described below.

- Australia commences with a New Apprenticeship system in January 1998 based on reforms to the pre-existing apprenticeship and traineeship systems
- NCVER research (Robinson 1999b) shows that while extensive research was involved in establishing traineeships in the mid 1980s, little research had been conducted into apprenticeships and traineeships since that time
- NCVER releases a range of new statistical publications showing apprentice and trainee trends and developments
- During 1999 the NCVER embarks on a series of face-to-face briefings about apprenticeships and traineeships with government officials, national employer bodies, industry training oganisations and national trade union leaders
- During 1999 the NCVER decides to undertake major new research in apprenticeships and trainees. 12 new research projects are commissioned. By the end of 2000 two major reports will be released. These are an NCVER report providing one of the most detailed analyses of apprentice and trainee trends, developments and emerging issues ever undertaken, with an accompanying volume of authored research papers reporting the findings of the new research studies that are being conducted
- Late in 1999 the national minister calls together national employer organisation to discuss emerging trades skill shortages. NCVER is asked to provide a presentation at the meeting
- Three employer-led working groups are established to examine trade skills shortages and the electrotechnology, metal fabrication and engineering, and automotive industries. NCVER is one of the members of each working group and provides considerable analytical input to each working group's report back to the minister. The working group's findings are presented to the Minister at a National Skills Forum in April 2000, together with the announcement of new policy responses
- Early in 2000 the heads of Australia's training authorities request that NCVER commission a major new work to look into reasons why some apprentices and trainees fail to complete their training and make recommendations about what strategies might be put into place to address the problems the research identifies
- Three new national skills working groups are announced in April 2000 to examine trade skills shortages in the building and construction, food and rural industries, with NCVER membership again being invited

This demonstrates in a very tangible way how more emphasis on the dissemination and utilisation of research results has developed into greater calls for research and analysis to become more integral to policy development itself.

CONCLUSION

In this paper we have examined the different ways in which research can have an impact on policy development, so that real improvements to the quality and effectiveness of VET can result from the research, information-gathering and analysis effort. Australia's National Centre for Vocational Education Research has responded to this challenge by changing the ways in which the information about VET research and statistics which it produces, manages and collects is disseminated to all stakeholders.

The new approaches focus on: making sure that VET research is focused on the real information needs of key groups in the sector; making sure information is produced in a variety of forms and that it is timely, useful and has the maximum impact; improving the quality of the publications and making them more accessible; producing products which consolidate and report on a range of the research and statistical work conducted on key issues and topics of interest in the sector; ensuring that as many as possible have an opportunity to see and hear what we are doing.

This approach is evolving in a new and exciting way that leads to a quite different chronology. This is when the need for policy development itself instigates the research. Instead of asking how to make research relevant to the decision makers, perhaps a better question is how policies can be made much more relevant and useful, and durable. The answer is that they must be backed by sound research. A better balanced strategy is achieved when people are appointed to undertake genuine investigation, with fiscal responsibility and political cognisance. There is need for a fine balance between genuine enquiry and real political possibilities. Part of the role of a national research organisation like NCVER is to maintain that balance. Consciousness of the need for policy relevance should be there from the ground up, in the planning and undertaking of research and the dissemination of the findings.

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NCVER'S WEB SITE AND THE VOCED RESEARCH DATABASE

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Index: Vocational education and training; Database; Educational research; World Wide Web; Information dissemination; Information network

Abstract: This paper discusses the use that Australia's National Centre for Vocational Education Research (NCVER) makes of the World Wide Web as a major platform in its dissemination of vocational education and training (VET) information, the importance of which was explored in the first paper. The session included a live demonstration of the web site, with a particular focus on the VOCED research database. Over the past year, NCVER has extensively upgraded its web site, to provide an integrated and sophisticated source of VET research and statistical information. During this period, the VOCED database has been significantly enhanced to become a leading international research tool, containing information about VET research and policy from Australian and international sources, from 1995, and indexing a wide range of key journals in the field.

INTRODUCTION

Chris Robinson, in the first paper of our symposium, made clear the importance placed by Australia's National Centre for Vocational Education Research (NCVER) on the dissemination and utilisation of its research and statistical information about vocational education and training. For research to make a real difference and to have an impact on both policy and practice, the message about the research must get out to all those who need it. Getting this message out is as important as the production of the information by doing the research.

NCVER collects national statistics and undertakes and manages a large number of research projects each year. We thus hold a vast amount of research and statistical information about vocational education and training and have developed a range of strategies for getting this information out to the people who need it. One of the chief vehicles for delivering this message is the World Wide Web, which enables us to use a very flexible and powerful mechanism to deliver large amounts of information at a relatively small cost. The Web is the most effective way to reach a wide range of people, as it becomes increasingly more widely used, in Australia and in the rest of the world.

This session will outline our strategy for NCVER's web site as a whole and then look particularly at our *Vocational Education and Training Research Database* (*VOCED*), which has undergone a major enhancement over the past year.

The approach we have adopted with the web site is to offer an integrated service, so that our users can find both research and statistical information about their specific topic or topics of interest. Users can browse by category, or can use a free text search across the whole site. Information is kept as current and up-to-date as possible, a very important advantage of web technology.

We take a continuous improvement approach to the web site as a whole and this session will demonstrate how we have implemented new features in *VOCED* in response to clients' feedback. We seek responses from our users, and because the site is developed and produced in-house we are

able to respond to comments and add refinements. The site offers flexible and sophisticated searching mechanisms and is metadata driven for greater efficiency. An advantage of the web is that we are able to gather statistics about usage of the site, to monitor usage and see the growth in access.

This session will demonstrate features and services we have developed on the site as a whole and outline plans for future developments. The presenter will then look in detail at the *VOCED Research Database*, outlining the major enhancement project we have undertaken, and demonstrating the range of material now covered in this database as well as features of the search engine.

NCVER'S WEB SITE

http://www.ncver.edu.au

The following features will be demonstrated:

and to the key functions of the site. These links are maintained on each page of the site. All pages on the site follow the same clean design (to promote speed) and have the same 'look and feel' for coherence. Content is updated regularly. The mouseover feature allows extra information to be added without cluttering up the page. Address and contact details are provided on the front page – people shouldn't have to delve too far for this information.

NCVER structure and corporate information. Information about the organisation's aims, role and structure is provided, with photographs of managers and names and email contacts for key staff and functions.

NCVER news. Current and recent information is provided, with links to external sites where appropriate (contacts for conferences, etc). Email subscription to this newsletter is under development.

New web pages are featured so that regular visitors can quickly find changes.

Other key areas of the site: Library, Reading room, Bookshop, Links, Sitemap.

Research information. Research information is organised under themes, projects and currency, and can also be searched by key words. The master page for each research project contains links to all related information about that project, and also leads to further information about the research topic or the author. Increasingly, full text of publications (reports and papers) is available for download.

Statistical information. Statistical information is grouped under four main areas: national collections, surveys, selected topics and the AVETMIS Standard. Full text of many documents is available. It is planned to add metadata to all statistics pages (including tables and charts) on the web site so that they can be searched separately.

A full site search, from the sitemap area, will retrieve material about that topic from both the research and statistics areas, as well as other general information.

Further developments for the site as a whole include: increasing numbers of NCVER publications available in full for electronic download, in pdf format; an enhanced annotated VET links service, available as a searchable database; extension of the metadata used on the site, to incorporate all research and statistical information; online forums provided, based around particular topics of current interest; full online ordering service available from the bookshop; search facility added to the newsletter archives.

VOCED RESEARCH DATABASE: BACKGROUND

VOCED is produced at NCVER with the support of Australia's national VET clearinghouse network. The network has existed for over 20 years, and was set up with the aim of avoiding unnecessary duplication of effort in technical and further education (TAFE) research. This aim of course remains a key focus of our work today. The TAFE Clearinghouse was modelled on the ERIC Clearinghouse concept, where information related to published and unpublished material (in this case about vocational education and training) is sent to a central point from various formal nodes as well as from individuals, thus forming an information network. The Clearinghouse started with six State and two Territory Clearinghouses, plus the National Clearinghouse. In 1989 the title of the network changed from National TAFE Clearinghouse to National Vocational Education and Training Clearinghouse, reflecting the increased coverage of the information beyond just TAFE to incorporate information from the entire VET sector. The *Vocational Education and Training Research Database (VOCED)*, also came into existence, incorporating the two existing hard copy publications (*Initiatives in TAFE* and *Projects in Progress*), and produced in an electronic version (distributed on diskette) as well as hard copy. Since then it has been produced quarterly, and now contains almost 15,000 records, of which about 4,500 are international entries.

The network itself has expanded to its present structure, consisting now of a Clearinghouse in each State and Territory, an adult education Clearinghouse based in the Council of Adult Education in Melbourne, a New Zealand Clearinghouse, a local UNEVOC Clearinghouse and the National Clearinghouse at NCVER. Each local Clearinghouse captures information on vocational education and training from its own area, houses the documents, sends abstracts, indexes and bibliographic information about the document or projects to the National Clearinghouse, ensures access to the documents themselves and distributes and promotes the database to its own constituency.

The National Clearinghouse at NCVER is responsible for producing the database from this information, maintaining its quality and consistency, capturing national information and other information not covered by the network, and co-ordinating the network as a whole. This system has worked with goodwill and a spirit of co-operation for 20 years. The Clearinghouse officers throughout the network are a highly committed group of people who are driven by a strong ethic of collaboration and information sharing, and this is one of the reasons for the successful continuation of this system.

The new developments in the Clearinghouse and database are building on a solid foundation developed over many years - the network is a well set-up and healthy co-operative venture, where all users benefit and can see that they benefit. The Australian TAFE systems which house the local Clearinghouses contribute to the network by providing time and labour; they benefit by having ready access to a mechanism for promoting their information, and for obtaining timely and relevant information themselves. As more TAFE institutes become interested in undertaking research, and in producing reports on their findings and on initiatives in their practices, they can see the benefits of being part of a national coordinated system for sharing this information.

The information contained in the database includes:

- research reports
- information about current research (projects in progress)
- conference papers
- theses
- journal articles

- policy documents
- government reports
- evaluation studies
- survey results
- published statistics
- bibliographies
- electronic documents

These are not kept in full text in the database, but are housed in the Clearinghouse, and for Australian users every document entered is available by some means (usually interlibrary loan) from a specified source. Wherever possible, a second point of availability is included so that international users are given a way of obtaining the full document. Increasingly, documents are available on the web, and where this is the case a link is made to the full document from within *VOCED*.

Each entry in the database contains a brief abstract or description of the document, an extremely valuable aspect of the database. Contact information is provided for current projects.

VOCED RESEARCH DATABASE: ENHANCEMENTS – RECENT, CURRENT, FUTURE

Access via the web

Enormous changes to the potential usefulness of the database resulted from mounting a web version. This has many benefits: users can have access from their own desktops, without relying on knowing that the system is installed in a library somewhere. They can use the mouse and hyperlink features, and cut and paste text. They can use the e-mail links to clearinghouses provided on the web site to request items and they can submit information to us about projects or documents online. It has become a truly interactive and accessible database. Our feedback from clients about the interface has been very positive, with very few enquiries about how to use it. We have provided help information and examples on the site. Our statistics kept over the first 18 months since *VOCED* was mounted on the Web showed a steady 400 actual searches performed each week. This initial high usage for such a specialised database has increased over the last year to an average of 800 searches a week, indicating the success of the enhanced service.

With *VOCED* on the web and readily accessible to all users around the world, we were poised to expand to become providers of a truly international tool, and to increase its coverage to include not just more Australian material but key international material as well.

Increasing coverage – becoming international

VOCED has grown from what was a national and somewhat limited, though useful, database, to become a leading international research tool for the field of VET. To increase coverage, we have been adopting a number of strategies.

Firstly, strategic alliances with relevant organisations, initially the 20 or so research centres which have been set up around Australia and are undertaking research into VET. The research context is very different now from when the Clearinghouse was first set up. Research is now not just done in the TAFE and training authorities, but in many specialised research centres, in universities and TAFE Institutes. NCVER has signed memoranda of understanding with over 20 of these centres,

whereby, among other areas of cooperation, we agree to exchange documents. This means that in exchange for all of our publications, these centres send us everything they publish, of relevance, and we can then include it in the database. This results in the capture of a significant portion of key Australian VET research material.

Secondly, NCVER now plays a central role in coordinating the dispersal of funds for the national managed research program, overseen by NREC, the National Research and Evaluation Committee. This means that as soon as a project contract is signed, we can put the project information into the database, and we also have speedy access to the published outcomes, for inclusion in the database. We liaise closely with the section managing the NREC funding so that we can gather this information quickly.

With these two strategies in place we are able to be far more proactive and ambitious about capturing Australian VET research information. Where before *VOCED* had many acknowledged and frustrating gaps in its coverage, we are now in a position to aim to be comprehensive for Australian research information.

As well as becoming more strategic in acquiring information, we have also become more focussed on the nature of our core information. *VOCED* contains information on VET policy and training systems, VET research, VET practice including "how to do it" information from practitioners, and published statistics (ie not raw data). We no longer include curriculum material, as we did to some extent in the past – this is too vast a field and there are other sources for this.

We have also set up similar MOUs with a number of international organisations, so that we can also be sure of capturing all their publications. These are at present: South East Asian Ministers of Education Organisation Regional Centre for Vocational and Technical Education (SEAMEO VOCTECH), Colombo Plan Technician Staff College (CPSC) in the Philippines, the Overseas Vocational Training Association (OVTA) in Japan and the Korean Research Institute for Vocational Education and Training (KRIVET). Further agreements with the European Centre for the Development of Vocational Training (CEDEFOP) and the German Federal Institute for Vocational Training (BIBB) have just been established and an agreement with the Central Institute of Technical and Vocational Education (CITVE) in China is about to be signed.

We have a very strong link with UNESCO's UNEVOC program, including a local UNEVOC clearinghouse node, and are in the process of developing an agreement with Adelaide Institute of TAFE to become a joint regional UNEVOC Centre of Excellence, one of whose platforms would be the production of the *VOCED* database, as a vehicle for all VET research information published in English, for and from UNEVOC members.

Our strategy for acquiring information for *VOCED* is essentially a two-pronged approach. On the one hand, we make use of all of our networks: the Australian national clearinghouse network, the Australian research centres, the Australian national managed research program and the growing group of international partners, and the online submission mechanism, to acquire a wide range of material which is sent directly to us. This does mean we have a large amount of more obscure and rare documents, including unpublished papers and material from the Asia Pacific region which is unlikely to be held by any other database, and which is one of the great strengths of *VOCED*. On the other hand, to ensure the widest possible coverage, we have also strategically and systematically set about funding the acquisition of key material from a number of key sources.

Journals

In the past, *VOCED* did not routinely index many journals. Our coverage was sparse and sporadic. Now we have identified an initial set of key journals in the field and acquired them for the collection, backdated to the beginning of 1995. Our list of both Australian and international journals

is now over 130 titles, and we are constantly looking for new ones. We have added 10 new titles this year. The next stage of the project will include an evaluation and refinement of our core list of journals. We are always keen to receive feedback on this list, which is itself published on the web site, with each title linked to its entries in *VOCED*. The list itself is a valuable resource.

Monographic publications

Similarly, we have at the same time set up a process of identifying key international publishers and organisations which produce relevant monographic (single) publications in the field of VET research and policy. These include the obvious ones such as OECD, CEDEFOP, the ILO, NCRVE in the US, etc but we want to cast a much wider net and identify the key research organisations in the area in a wide range of countries. Again, any suggestions here would be warmly welcomed. I have a list of over 140 organisations at this stage, which we may put up on the web as a resource in a similar way to the journals list. Again, we are going back to 1995 for our acquisition of this material as well. Most of these organisations have web sites and will eventually be included in the "annotated VET links" section of our web site.

Implementation phases

The enhancement is taking place in two phases. The first phase, of identifying, acquiring and indexing the backdated material, is almost complete. It began in March 1999 and will be finished by the end of September 2000. We have ordered approximately 100 new journals, acquired the back issues to the beginning of 1995, and have indexed them, working from the most recent to the earliest. We have also acquired large numbers of international monographic publications (over 2,000) for indexing, from about 150 different international organisations so far.

We are using a team of in-house indexers to maintain our existing very high standard for entries. For *VOCED* to be a world class international database, it is crucial that the quality of the abstracts and the assignment of index terms are to the highest possible standard, and part of this project has involved the refinement and development of our existing standards and guidelines for data entry.

As well as the high quality of the entries, the range of its coverage, the fact that it is free to use and the backup document delivery service, *VOCED* has another significant advantage: its timeliness. Because we put the entries in ourselves at NCVER as soon as we receive the material, there is rarely a wait of more than three months (our upload period) before an entry appears in the database for a publication. This is in striking contrast to the time taken for material to appear in many other databases. We hope always to be able to maintain this currency of the items in *VOCED,* and we urge all users to send us information about projects and documents as soon as possible so that they can go up onto the web quickly.

The maintenance phase will continue after September 2000 with 2 full-time continuing indexing positions, a consolidated list of evaluated serials, and a list of target organisations to monitor for publications. Our strategy of alliances with various organisations to acquire their publications for the database will continue. We anticipate that *VOCED* will by then be an indispensable tool for VET research and a first port of call for anyone in Australia (and indeed the rest of the world) who is seeking information on vocational education and training research.

It is important additionally to note that *VOCED* not only provides a single point for Australian VET researchers, policy makers and practitioners to access international information, but also offers an opportunity for those in the Australian VET community to showcase their research and policy information. A search in *VOCED* now results in a consolidated set of results which is a mix of Australian and international material. In providing this tool, one of our aims is to enable Australian researchers more easily to cite international research in their own papers as well as to promote their

own work in the international arena. Australia has a thriving and focussed VET research program, which has much to offer the rest of the world, as well as much to learn from international research and policy material.

Further refinements to the *VOCED* search

Several refinements to the *VOCED* search mechanism have just been completed and we always welcome suggestions for more. One of the advantages of developing the tools in-house is that we can customise the search engine and be responsive to users' comments, requests and suggestions.

The new improvements are:

- Truncation of the search term
- Linking the search to an online thesaurus for automatic checking of key terms
- Returning the set of entries retrieved in a format which is compatible with bibliographic programs such as EndNote.

These changes are complex in themselves, but they will make searches easier for the user, and we have made various decisions about how to present the new functionality in the search interface which need to be evaluated by our users.

Other planned changes are:

- Modification of searches by date
- Adding "pathfinders" to the web site
- Putting the thesaurus itself on the website for browsing and use by other sites, in particular for metadata
- Developing Z39.50 compliance so that *VOCED* can be compatible with other web databases and can more readily be part of internet gateway or portal sites

DEMONSTRATION

The second part of the workshop consisted of a demonstration of the *VOCED* research database on the web, with examples chosen to show different kinds of searches and the range of material now covered.

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THE RENAISSANCE OF VOCATIONAL EDUCATION AND TRAINING: MISCELLANEOUS HINTS FOR UNDERNOURISHED ELEPHANTS YEARNING TO DANCE

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Key word index: VET systems, management, competing influences.

Abstract: This article considers the influences on VET delivery and highlights concerns for systems contemplating change. It comments on the purpose of VET and the way VET systems are managed.

Most publicly funded Vocational Education and Training (VET) systems throughout the world, dressed in their various garbs, are elephantine and bureaucratic. Whilst there are notable exceptions, most hobble along, weighed down by a miscellany of agenda, in a world moving at cyberspeed.

Globally, VET is at the crossroads. The renaissance of global VET requires energy stimulated by a vision of tomorrow rather than the frameworks of today or yesterday. In attempting to reinvent its value, in an era marked by exponential change and discontinuity, it is at risk of accepting that any new direction is good enough. If the system does not know which route to travel, any path will do.

TRIANGULATED PILLARS OF VET MANAGEMENT

VET systems are predominately publicly owned and managed. Both the providers and the systems are subject to competing pressures and have been drawn into the reforms of the western world's public sectors. Public VET providers are largely centrally funded and controlled, with different levels of delivery-based autonomy.

Western-world VET sits in the eye of a storm rampaging simultaneously on three fronts: from the new world operating paradigm of globalization, evolving technologies, changes in work and social values; from higher education providers who, throughout the world, have experienced radical increases in student numbers without commensurate funding adjustments and thus have pursued new markets (such as VET); and from increased economic drivers resulting from public sector management reforms. Faced with this environment, distinct VET systems, if left unmanaged or managed in traditional bureaucratic ways, will become unsustainable and are likely to prepare students for a world that has disappeared.

It is difficult to make global statements about the world of VET. VET commentators within industrialized countries frequently ignore the basic needs of much of the world where two thirds of the global population can only access clean water by carrying it themselves from water courses and 80% of the world's population have never used a telephone, let alone sent an e-mail message. The industrialized countries, with only 15% of the world's population, contain 88% of all internet users. Even if appropriate telecommunications systems were in place, without literacy and basic computer skills, most of the third-world's population would still be excluded. To close the knowledge gap generated by technology and globalization, the first step is to address the learning deficit in the

third-world where, in 24 countries, 20% of primary school aged children are not in any educational system.

The delivery of VET, irrespective of the host country, is supported by three pillars: money and economics ("the financial pillar"), political and ideological considerations ("the political pillar") and community, local and social issues ("the social pillar").

Social Pillar

VET providers usually discharge a significant social responsibility by reaching the unreached and including the excluded. VET expands access to education for the socially, educationally and economically disadvantaged. It is low cost, accessible and non-threatening. VET students commonly come from the lower socio-economic groups, many are mature-aged and most have no or no significant previous academic certification. VET fulfills a need for "second chance" education and retraining. VET also meets a social need for aligning education with the skills required in the future workforce. In many cases, VET providers pick up the pieces left by the failure of the economically driven markets to meet social obligations.

Political Pillar

VET providers support social infrastructure, contribute to regional growth, provide employment and are often significant local participants in economic development. As State owned organizations or at least largely government-funded bodies, VET providers react to the political ideology and imperatives of government. Efficient and effective program management does not necessarily achieve the social or political outcomes required by government. The political environment of public sector activity is an important influence on public sector management.

Financial Pillar

The raisen d'être for VET is not the financial well-being or strength of the provider or the system. It exists to meet a broader social value. However, governments expect their agencies to operate both effectively and efficiently. This is particularly so today, as evidenced by such programs as the UK's "Next Steps" initiative, New Zealand's "State Sector Reform Program", Australia's "National Competition Policy", Canada's "Public Sector 2000" initiative and the USA's "Reinventing Government" program.

Public sector managers have been induced away from an adherence to inputs-driven and formalized processes to an emphasis on optimal resource allocations, outputs-driven strategies and value for money. The key changes to the management of publicly funded organizations include a strategic management focus, a shift to quantifiable output measurement, the devolution of management controls within an agreed performance framework, a preference for private ownership and contestability in public sector service provision, the imitation of private sector management practices and an emphasis on cost-cutting and efficiencies.

Economic considerations are always high on government agendas. Governments and the public expect VET providers to operate frugally. That alone, however, is not enough. They can operate efficiently and still not achieve the social and political outcomes expected of them.

The nature and function of VET providers have substantially diversified in recent years. This has resulted in a diversification of funding sources (UNESCO, 1999, p.10) which, in turn, has intensified the focus on funding and financial efficiencies. In practice, the loose-tight controls of government may have been antithetical: loose when they should be tight, and tight when they

should be loose. VET providers, with operating systems glued by public sector impediments, have been asked to act like businesses and have been judged like private providers (Queensland, 1998).

Diagram 1 depicts the triangulated model.

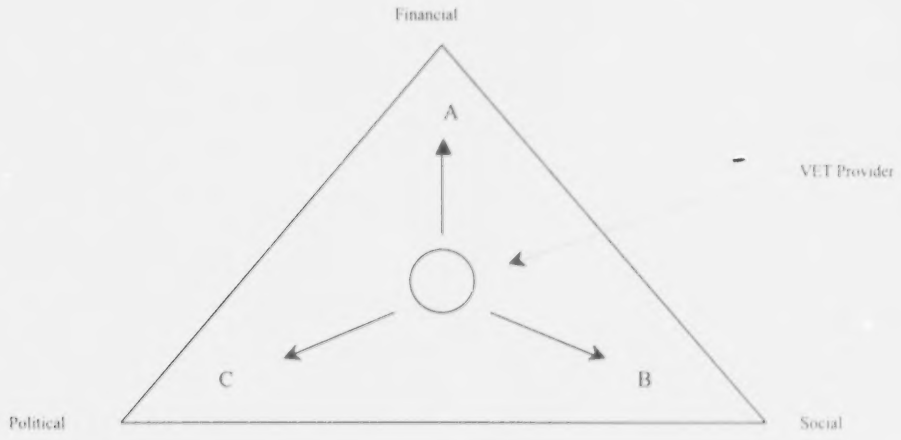

Diagram 1

Providers positioned at point A in Diagram 1 will only provide programs if they are profitable. In order to survive, their fee-for-service revenue must significantly exceed their government funding. They are unlikely to have many supporters in government as they divorce themselves from political imperatives and, more significant, from the community, social and support imperatives traditionally met by VET. They will have little connection with local communities.

Providers positioned at point B in Diagram 1 will be driven by the social pillar of VET provision. They will not pursue financial strength or short term financial profit and will probably be managed inefficiently. They ignore the short-term idiosyncratic demands of local politicians and the broader imperatives of government and public sector reforms.

Providers positioned at point C in Diagram 1 will be consumed by political imperatives and the demands of Ministers and local members. They will constantly divest resources to pursue short-term interests of stakeholders and will be unable to maintain any constant strategic growth consistent with financial survival. They ignore the broader learning framework of VET and will be unable to adjust to the contemporary needs of students and industry.

A provider often "bounces around" inside the quagmire of the triangulated framework propelled by the particular imperatives of the day. Different governments with different ideologies will attempt to position VET towards one or other pillar in the framework. It is unwise to accept long term positioning near any one particular pillar without embedding a flexibility to adjust towards another pillar should medium term circumstances dictate. This is due to VET's status as a tool that meets a variety of agendas. There is a trade off between the three pillars.

KNOW WHAT YOU ARE

VET is a difficult concept to define. Generally speaking, it is an outcomes based phenomenon. It is usually understood to mean all learning experiences that directly enhance the skills, knowledge, competencies and capabilities of individuals, required in undertaking gainful employment. VET provides technician, craft and trade type 'middle-level' skills and knowledge. It is essentially practical, applied, technical and job-related. However, rapidly changing technology, globalisation, organisational change, the development of the 'knowledge society' and the market-oriented, deregulatory policies of governments have blurred the boundaries of the sectoral/skill-level notion of VET. Its focus is on the nexus between education and training, in all their forms, at all levels, and employment, whether paid or unpaid, and the economy. It calls for a multi-disciplinary approach (Maglen, 1996).

VET is a process in pursuit of an outcome. What it is, is less important that what it produces: how it is delivered is less important than the product of the delivery process. Yet the scuttle-but of hearsay around VET corridors increasingly infers that VET in the new millenium may shift to become applied vocational skills defined by reference to pedagogue, basically work place (or application) based and applied learning, rather than the qualification produced, the skill level acquired or the employment opportunities which it creates. This, so the scuttle-but continues, is dependent on policy. Most VET providers see themselves as implementing government policy. However, policy creation and implementation are iterative and interwoven. To echo Mintzberg (1996), policy implementation involves policy determination and re-creation. Administration is not just a question of efficiency and rational rules: it inherently involves policy choices. In this sense, VET managers have a degree of autonomy independent from government. The key to shaping that independent capacity is to ensure that it is exercised speedily and in a way that is relevant for the world of today and tomorrow, not perpetuative of the world of yesterday. It is within this crevice of implementatory discretion that centralised, bureaucratic systems can leap forward into tomorrow.

FUNCTIONALITY OF VET

VET systems exist for the students and the creation of skills and competencies needed for tomorrow's world. The system itself has no intrinsic worth. Most state based education systems are a vertically integrated process and often a vertically integrated monopoly. Many western world public sector reforms have sought to unbundle the vertical integration by segregating the various parts of the process into different units, with these units then dealing at arm's length with each other. This process has been pursued, for example, in water, gas and power industries. It clarifies the cross-subsidies between zones of activity and makes the "chunks" of the process financially transparent.

Publicly owned VET providers are vertically integrated. To use a water industry analogy, VET providers control the data and knowledge catchment, storage, treatment and transportation. Global VET providers are very good at catching the rain and harvesting the raw materials. For many years, teachers and educators became experts at treating the raw materials to align them the required skills or, using our analogy, the type of water required. They are less adept at this today as the skills needed are changing rapidly. Interestingly, throughout the world, enormous resources and energy are being directed at developing mechanisms to address this gap. It is astounding, then, that so little attention or resources have been diverted to the pipeline – the distribution networks. Water engineers know that a weak pipeline causes enormous potential risk. The raw water may be of excellent quality, or poor water treated usually at a significant cost, but a leak in the pipe undoes all

the hard work. Industry knows that you cannot sell the world's best product without a good customer interface and distribution network. Teachers have not received the same attention. In many countries, VET teachers are deficient in their theoretical or practical skills (UNESCO, 1999, p.7). A new model of the VET system should see the role of teachers re-appraised with skill mixes and pedagogue reinvented. Teachers will be re-skilled on the job and probably in their own time. They will acquire new entrepreneurial skills by an increased interaction with industry and the community. Using the water analogy, water engineers no longer invest in new copper or cast iron pipe when a cheaper more flexible and durable pipe can be used. If global VET should adopt a business model then it must recognize that no business spends so little on its distribution network and customer interface. Its leaders should reappraise the historical under-investment in teaching skill maintenance and development.

INNOVATION AND THE NET: ONE SIZE DOES NOT FIT ALL

VET organizations have objectives framed around learning. Different VET providers specialize in different disciplines or markets. Within faculties, there are sub-streams of interest and specialities of learning. One teaching methodology may not suit every type of learning process. Teaching is a process. Learning methodologies are processes. They are means to an end. One "size" does not fit all. Each particular circumstance needs to undertake assessments of appropriate methodologies.

The internet and web based delivery is a particular delivery and learning methodology. It will suit some types of programs and some students. The focus on internet delivery is important but it is not an all-consuming panacea for the future. It is a strategy that supplements other methodologies rather than supplants them. In the absence of the young generation of today cloning their learning attributes - and there is no evidence to suggest that that is so - then there is and will remain a demand and educational integrity in a variety of delivery methodologies.

In the discontinuous world of the new millennium driven by rapid technological change, globalization, economic uncertainty and diminishing resources, the real key to the future of a reinvented global VET provision is innovation (beyond flexible delivery), rather than planned structural processes. VET providers will be doomed by repressed, centralized, dictatorial managerial styles and curriculum morbidity. Testimony to this is the global difficulties experienced by curriculum developers in designing and unleashing traditional curriculum in a world that moves faster than the capacity of traditional curricula development mechanisms. The curriculum is often redundant before delivery. The answer, of course, is to build a curricula framework and leave the detail to devolved experts at the grass roots who can adjust it to suit the idiosyncrasies of the market and the students as they try to align their skills with the rapidly evolving needs of industry.

VET providers are, by their nature, professional organizations. They are best managed "bottom up" rather than "top down". Hierarchically driven power produces resource misallocation in highly process-oriented front line staff. The result is a need to recognize that the centralized systems must move towards autonomous devolution with a clear vision of the future. Managers must move to individual autonomy and be accountable for results and co-ordination, not processes. The processes should be the responsibility of the teaching staff.

The traditional worldwide catch-cry in VET is that there is not enough money. There is, of course, never enough money. The trick is to recognize that solutions must be pursued outside traditional frameworks. Are the processes, for instance, still the right processes? Staff need to be stimulated to look for solutions which require reallocation of resources rather than new resources. Organizations need to address what they do and why they do it. No longer is it enough to say that particular

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processes are in place because they always have been. The challenge for VET leaders is to find new and better ways of producing enhanced outcomes with fewer resources.

An important ingredient to an enhanced future therefore is managed devolution. That however should only follow clarity of vision. The immediate task for most VET leaders is to define the future of VET in terms of positioning, outcomes and parameters. They need to focus on the values VET delivers rather than the more difficult contemplation of the abstract purpose of VET.

VET AS THE PRIME GLOBAL LEARNING FRAMEWORK FOR TOMORROW

VET teachers are often passionate about their work. Passion, however, often resists change. Passion driven in a particular direction, within particular parameters, is a valuable organizational resource. Managers should inspire passion in their teachers, but provide a framework for its pursuit. Inspiration of passion in teachers is rare without engagement of the teachers in the broader debate and without inclusive and participatory decision-making processes.

As VET leaders search for their own solutions it may be wise to recall that in rapidly evolving environments an investment in a solution provides only one answer and leaves begging the solution to the next question. Frameworks to guide multiple solutions are often better structures to build.

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INDUSTRIALIZATION, THE NEW ECONOMY, AND THE OCCUPATIONAL WORK ETHIC

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Index: Occupational Work Ethic, e-learning, Vocational Teacher Preparation

Abstract: The entrepreneurial spirit is alive and well in the new international economy. The information age, the internet, along with e-commerce, e-communication, and e-learning are changing the way businesses and workers interact, communicate and problem solve. The challenges of these multitude of demands on today's workers has greatly altered our traditional knowledge of the world of work. Vocational educators and trainers worldwide are now faced with a myriad of training challenges. Perhaps the most salient challenge is the understanding and communicating (teaching) of a work ethic suitable for the workplace of this new age.

INTRODUCTION

The Internet so commonly used today, began as the ARPANET during the cold war in 1969. It was developed by the U.S. Department of Defense's in conjunction with a number of military contractors and universities to explore the possibility of a communication network that could survive a nuclear attack. It continued simply because the DOD, it's contractors, and the universities found that it provided a very convenient way to communicate. (The Internet Economy Indicators,2000).

Today few would argue that the Internet is changing every aspect of our lives, how we work, live, play and learn. In fact, the Internet is emerging as a major force behind the strongest U.S. economy in history. A recent study by the University of Texas showed that the Internet economy grew to $523.9 billion in 1999, and now directly supports nearly 2.5 million workers, more than the insurance, communications and public utilities industries. Internet economy companies grew at an annual rate of 11 percent from 1998 to 1999, nearly three times the growth rate of the economy as a whole for the same period. The Internet economy is impacting businesses and governments on a global scale. Business leaders recognize the strategic role that the Internet plays in their company's ability to survive and compete into the next century.

Government leaders world wide, increasingly understand that the Internet will shape the future of their economic welfare and the welfare of their citizens. The Internet is driving a global economy that is creating unprecedented opportunities for countries, companies and individuals around the world. This past year, 17 Million US households were shopping online, with online retail sales expected to top USD $20.2 billion, and 56 percent of U.S. companies will sell their products online by 2000, up from 24 percent in 1998 (NUA/Forrester Research, 2000). Mediamark Research Inc. has released data which suggests that there are 64.2 million adults going online in the U.S. every month. (NUA,2000). The NEC Research Institute reports that there are currently 800 million pages on the web. A survey of 30,000 consumers in 30 nations found that the U.S. not only has the fastest-growing number of Internet users, but the largest proportion of e-commerce consumers. (Roper Starch Worldwide, 2000).

More than a million new jobs were created by the U.S. high-tech industry since 1993. (American Electronics Association) and this summer 82 percent of college graduates will search for careers and employment information online (NUA, 2000). Preliminary employment data show that the U.S. high-tech industry employed 4.8 million workers in 1998, making it one of the nation's largest industries (U.S. Bureau of Labor Statistics, 1999). Information technology sectors are growing at double the rate of the overall economy and have jumped as a share of the economy from 6.4% in 1993 to 8.2% in 1998. High-tech has driven more than a quarter of all economic growth since 1993. In 1965, high-tech's share of business spending was 3%. In 1996, it was 45%. In 1996, 7.4 million people worked in high-tech jobs, earning an average salary of $46,000, more than fifty percent more than the average wage of $28,000. (U.S. Department of Commerce, 1999).

Internet Usage WorldWide

In North America and Europe, 1 in 6 people use the Internet. (NUA, 2000). The number of women using the Internet worldwide will pass 96 million, or 45 percent of the world's Internet users in 2001. (Computer Economics, 2000). In 1993, there were 26,000 domain names in use. In 1999, there are 5 million web sites. (U.S. Department of Commerce/Netcraft, 2000). In 1993, 3 million people were connected to the Internet. In 1999, 80 million Americans are connected and approximately 200 million people worldwide. (U.S. Department of Commerce, 1999). 364 million PCs were in use in 1998. (Computer Almanac Industry, 2000). Today, over 50% of the online community originates from outside the US. (IDC, 2000). By 2005, non-US Web users are forecast to comprise 700 million of the total one billion users. (NUA, 2000).

The global e-commerce market is expected to reach $1.2 trillion by 2001. (Global Sight Corporation, 2000). In India, there is an immediate demand for 500,000 additional Internet connections and in Europe, 47 million households are expected to have Internet access by 2003. There will be over 24.3 million Internet users in Latin America by 2003. (NUA, 2000)

Changes in Vocational Teacher Preparation: During the past twenty years America entered the "post-Fordist" economy. This change in economic conditions created a blurring of traditional distinctions between mental and manual occupations and between academic and vocational education (Sharp, 1996). Sharp asserts that vocational teacher education must be changed so future teachers can develop a new core work force with the technical and interpersonal skills (work ethic) required for a less hierarchical workplace. Gregson (1993) supports this thought and contends that vocational teacher educators must learn to produce teachers capable of transforming their students into the critical thinkers and problem solvers needed to make workplaces more democratic and emancipatory. Miller (1996) claims the mission of vocational education (and thus vocational teacher education) should be based on the principles of constructivism. The cognitive approach should emphasize "constructing" knowledge through a problem-solving process designed to produce "learners who are problem solvers, lifelong learners, makers of meaning, collaborators, change agents who are also able to change, and practitioners of democratic processes"(p. 69).

Over 25 concepts/measures of worker commitment (work ethic) have been generated by researchers since 1956 (Morrow, 1983), some of these measures are: (1) the protestant work ethic (the belief that hard work is intrinsically good and an end in itself; Mirels and Garrett, 1971); (2) career salience (the importance of work and a career in one's total life; Greenhaus, 1971; (3) job involvement (the degree of daily absorption an individual experiences in work activity; Lodahl and Kejner, 1965); (4) work as a central life interest (an individual's preferred locale for carrying out

activities; Dubin, 1956); Taveggia and Ziemba, 1978); and (5) organizational commitment (the extent to which an employee desires to remain in an organization, exerts effort on its behalf, and believes in an accepts the organization's values and goals (Mowday, Porter, & Steers, 1979

Lankard (1995) citing the work of others states that Generation X, the population cohort following the Baby Boomers, do not have a poor work ethic - they just view the concept of career differently. A Swedish study on the work attitudes of young people supported this finding. Young people possess internal or postmaterialistic values in addition to more traditional values associated with work. Girls ranked higher on intrinsic work goals than economic ones (Hagstrom & Gamberale, 1995). Many studies on work attitudes or values of young people cite degrees of dissatisfaction with their "work attitude" (Capelli & Iannozzi, 1995). The perception that there is a problem with the work ethic of younger workers, and that more effort should be made to teach work values was found to be held by employers (Florida State Department of Education, 1991; Donsky, A., & Others (1994); Ford & Herren, 1993; Cappelli & Iannozzi, 1995), teachers (Gregson & Bettis, 1991), parents and principals (National PTA, 1992), and government (Nierdergang, 1992; National Council on Vocational Education, 1991). A review of the literature revealed the greatest effort being made to teach work values is being undertaken by vocational education.

Teaching Work Ethic: Regarding the teaching of work ethic values, Ford & Herren (1995) in a survey of 160 work program coordinators in Georgia, found that coordinators felt that the teaching of work ethics in their classrooms was largely informal or unintentional. Cherrington (1980), in discussing the teaching of work ethics values, stated that indoctrinational strategies are commonly used. However, Gregson & Bettis (1991) through a series of interviews with trade and industrial instructors across Virginia, did not find evidence to support the contention that vocational instructors use primarily indoctrinational strategies to teach work values and attitudes. Although reward structure and role modeling were used extensively, more democratic strategies, such a group discussion, on-on-one counseling, and role-playing were also frequently used.

International Work Ethic: Two studies were found which investigated differences of culture among countries regarding work ethic values. Another study sought commonalties. One study examined country group differences in economic beliefs and attitudes (Furnham, Kirkcaldy, and Lynn, 1994). Nearly 12,000 students from 41 countries completed questionnaires measuring 7 traits: work ethic, achievement motivation, mastery, competitiveness, and achievement through conformity, money beliefs, and attitudes to saving. The authors found that countries from North and South America scored highest on work ethic and mastery while young people in Far and Middle Eastern countries reported the highest competitiveness and acquisitiveness for money. Another study specifically measured and compared Protestant Work Ethic scores in13 countries, utilizing 7 work ethic scales with varying reliabilities and validities (Furnham, Bond, Heaven, and Hilton, 1993). There was a highly significant difference between the scale scores of the subjects from the different countries, and the differences tended to be consistent for the disparate measures. Subjects from richer, First World countries tended to have lower scores than those from Third World countries. Also, the authors discovered a significant correlation between the most well known work ethic scale score and G. Hofstede's power-distance score, indicating that work ethic belief is associated with the amount of weight that is placed on prestige, power, and wealth in a society. Giorgi and Marsh (1990) reanalyzed data from a 1981 European values survey to (a) determine the existence of a consensual work ethic among modern industrial societies and, (b) examine the link between work ethic and religion. France, Italy, West Germany, the United Kingdom, Holland, Belgium, Denmark, and Spain comprised the country groups. These Western European cultures appeared to embrace similar values associated with work. Specifically, the authors discovered what

they called a "vocational work ethic", which stresses the rewards of self-fulfillment and social obligation. This ethic, in turn, was linked with religious denomination and degree of religious fervor. Also, people who had more education had higher work ethic values.

Among the more recent instruments are Ray's (1982) Eclectic Protestant Ethic, Ho's (1984) Australian Work Ethic; Wayne's (1984) Protestant Ethic and Contemporary Work Values; and Petty's (1990) Occupational Work Ethic Inventory. The value and definition of what is generically called the work ethic has undergone a transformation from the foundations of the concept as it was originally conceived and applied during the agrarian and industrial periods of history. These instruments were developed in order to better match the conditions of the modern workplace and the exigencies of the modern worker in the information age.

Petty's Occupational Work Ethic Inventory (OWEI)

Petty's Occupational Work Ethic Inventory was developed and tested by Petty (1991a). As it is normally used, the OWEI instrument consists of three segments. The first segment introduces the instrument, provides instructions for the participant, and assures confidentiality. The second segment represents the scale of 50 items. And the third segment is generally attached in order to gather demographic information from the respondents. The **Occupational Work Ethic** is defined by Petty as: *the displayed behavioral characteristics (work habits, attitudes, and values) based on an individual's personal values and mores while working for income within a paid occupation (versus sports, religious activities, hobbies and other avocations).*

Petty's OWEI is based in part on the original work of Dr. H. C. Kazanas at the University of Missouri in 1977-1978. Dr. Kazanas' (1978) empirical investigation was related to affective work competencies and work values, with an emphasis on how to measure them. Utilizing the affective work competencies phrase list extracted from a population of workers, supervisors, and vocational educators (Petty & Morgan, 1980), Petty then set out in 1990 to develop a new instrument which could use these terms to measure work ethic characteristics directly related to a person's work. A panel of subject-matter experts was used to establish content validity through a form of semantic analysis, which entailed the categorization of simple one or two word descriptors into groups. Independent categorization and re-categorization took place until a consensus was reached (Petty, 1991a). The resulting clusters were labeled Dependable, Ambitious, Considerate, and Cooperative. A 1995 study by Petty gave four clusters: interpersonal skills, initiative, being dependable, and reversed items. An anchor or stem phrase of "At work, I can describe myself as:" was added to direct the participant to their responses. A Likert-type scale was provided for rating participant standards for each item: 1 = Never; 2 = Almost Never; 3 = Seldom; 4 = Sometimes; 5 = Usually; 6 = Almost Always; and 7 = Always. A pilot study was undertaken later in the year. A coefficient alpha estimate of internal consistency was computed to be .95 (Petty, 1991b). As a result of this pilot analysis, all 50 of the OWEI items were left intact. A pilot study by Hill (1993) of 135 college students and staff employed in a small four-year liberal arts college was conducted in order to check the internal validity of the OWEI instrument. A computed coefficient alpha was .94.

Since 1990, numerous studies have been undertaken in order to measure work ethic attitudes using the OWEI, or investigate issues related to the instrument's validity. The following discussion focuses on issues pertaining to the validity of the instrument; a separate section will discuss research findings related to work ethic research in which the OWEI has been utilized. One of the first studies to utilize the OWEI instrument was undertaken by Hill (1993). The purpose of the study was to determine if there were significant differences in the work ethic of workers categorized by Standard Occupational Classification (SOC), level of education, age, gender, years of full-time

work experience, or empowerment. This study was unique in that it utilized respondents from randomly selected workplaces, covering a wide range of occupations, instead of the more commonly seen convenience samples. A multivariate analysis of variance procedure revealed significant differences in work ethic for all of the above groupings. Further analysis using a Fisher's protected LSD procedure was employed in order to determine precise differences for each of the independent variables. Differences for the four dimensions of the work ethic represented by the subscales of the OWEI were found for SOC, education, gender, work experience, and empowerment. The OWEI was found to be internally consistent and highly reliable, based on a computed coefficient alpha of .95.

A factor analysis was performed by Hill and Petty (1995) in order to identify key themes, which characterize the occupational work ethic and further refine the Occupational Work Ethic Inventory (OWEI). A principle-components analysis was performed; using squared multiple correlations yielded 4 factors, which met the Kaiser's criterion. A scree test was performed, and rendered a four-factor solution. Finally, orthogonal rotation using the Varimax procedure was employed, in order to minimize the number of loadings on a factor, which enabled the researcher to more easily interpret the resulting list of constructs produced via the factor matrix procedure.

The labeled factors were: **Interpersonal Skills** - comprised items which related to working relationships with other people and the general concept of cooperation; **Initiative** - incorporated items which dealt with the idea of ambition, "moving up the ladder", and adherence to a difficult job situation; **Being Dependable** - included items which had to do with fulfilling the (minimum) expectations of the employer for satisfactory job performance, including such things as punctuality and honesty; and lastly, **Reversed Items on the instrument** - This factor was made up items which were reversed and stated in the negative on the OWEI in order prevent participants from developing an unacceptable response pattern.

Research Studies Utilizing the Occupational Work Ethic Inventory

Hill (1993) undertook a study to determine if there were significant differences in the work ethic of workers categorized by Standard Occupational Classification (SOC), level of education, age, gender, years of full-time work experience, or empowerment. Among the more easily interpreted findings were those related to the level of education and gender groupings. The mean subscale scores of workers grouped by level of education increased sequentially for the subscale of *ambitious*. Significant differences were not found for the subscales of *dependable*, *considerate*, or *cooperative*. Level of education was partitioned as follows: group 1 - less than a high school diploma; group 2 - high school degree or GED; group 3 - two years of college or Associate's degree; group 4 - Bachelor's degree; group 5 - some graduate work. Females scored significantly higher than males on all four of OWEI subscales. Mixed findings for the variables of full-time work experience and empowerment do not appear to lend themselves to useful interpretation.

A study by Hatcher (1994) examined the work ethic of apprentices and instructors in a trade union apprenticeship-training program. The study revealed that there was a significant difference in work ethic for participants in the categories of occupation and job specialization. The author suggested that these differences might be due to the maturity of older instructors, more humanistic characteristics of younger apprentices, and the definitions of job specializations. A study by Petty & Hill (1994) explored the occupational work ethic of women and men. Women tended to be more heavily concentrated in occupations classified as technical, clerical, or sales and men were more evenly distributed across the SOC aggregate groups. The calculated results revealed that females

scored higher than males for every subscale (i.e. dependable, ambitious, considerate, and cooperative).

Petty and Hill (1994) stated that women exhibited a stronger work ethic than men did, which is consistent with findings of other researchers (Hall, 1990, 1991; Hill, 1993; Miller, 1980; Wayne, 1989). The research of Lyson (1984) and Miller (1980) was cited as evidence that women have different expectations from work. The importance of stressing these affective factors in the areas of teaching and vocational guidance, and especially the idea of helping students assimilate these factors are provided as important implications for this study.

A study by Hollingsworth (1995) examined the roles, together and separately, of leadership orientation and work ethic. It was discovered that the participant home economists emphasized the factors of (a) Dependability and (b) Interpersonal Skill, with the third factor of (c) Initiative being clearly distinguished as being the least important.

Petty published three studies in 1995 (1995a; 1995c; 1995d) that apparently used the same population/sample, but which focused on disparate demographics. The population for these studies consisted of workers from the mid-south region of the United States. From a master list of businesses and industries in the community, a sample of approximately 3600 possible participants was developed, utilizing a random block design, which included 200 industries. There were 2,232 observations used in the analysis due to no returns or missing values. The instrument used to gather data, the statistics used to analyze the data, and other incidentals of research were essentially the same as those used in the Petty & Hill (1994) study discussed earlier.

Through an examination of job titles, which comprised the sample, Petty (1995d), made the observation that the six SOC classification groupings roughly correspond to generally known teaching areas in industrial-technical teacher education. For the persons represented by this data set, the analysis reveals that self-rated work ethic does differ by occupation. Each teaching area group appeared to rate one or more of the dimensions of occupational work ethic as being more important; no one teaching group (SOC aggregate group) stressed all four dimensions equally. The primary implications of this study were stated to be the importance of teaching the proper attitudes that attend each occupational area, and the need for vocational guidance of students, that is, to better match student behaviors and attitudes with suitable occupational areas.

SUMMARY

A high-spirited work ethic is consistent with entrepreneurial success. The new international economy (complemented with the information age, the Internet, e-commerce, e-communication, and e learning) will require understanding and communicating (teaching) of a work ethic suitable for the workplace. The way businesses and workers interact, communicate and problem solve are creating new challenges for vocational educators and trainers worldwide. These new challenges have greatly altered our traditional knowledge of the world of work and our ability to teach the work ethic. This important ingredient to economic success must be further investigated and explored to develop better techniques for preparing tomorrow's workforce.

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TELE-OPERATION OF A MANUFACTURING SYSTEM FOR VOCATIONAL EDUCATION

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Index: Distance and open learning, Education on demand

Abstract: A flexible manufacturing system was designed and developed to become a decentralised modular network manufacturing plant in the Hong Kong Institute of Vocational Education (Chai Wan). The system consists of a flexible machining cell, flexible assembly cell, automatic storage system, a database server, web-server and video conferencing system which are to be linked by various networks internationally with other educational institutions or manufacturing sites.

Various areas for the development such as system layout, simulation, mechanical design, hardware and software development have been carried out. The current development is to establish a web-based control and training system to the customers or students. They can view the operation of manufacturing and assembly processes as well as access system data and information globally.

The aim of this paper is to report the tele-control development of the flexible manufacturing system. The development changes the current education process. The system provides virtual and animated images on design, manufacturing attributes and supports remote training. Students, at a distant location can acquire skills, production methods and access system data and information globally. Moreover, instant feedback from students is possible, as they can make criticism at any geographical area. Delivery of knowledge can now be on-line and in real time globally to achieve better result of education.

Students using this system can communicate with the system host using Internet or ISDN leased line directly. They can submit task on various manufacturing processes and control of industrial robots through Internet or intranet. Host's feedback to students is also provided in order to enhance the learning process.

INTRODUCTION

A Flexible Manufacturing System (FMS) [1,2] has been designed and developed in the department of manufacturing engineering, Hong Kong Institute of Vocational Education (Chai Wan) to become a decentralised virtual modular network manufacturing plant named as Tele-presence Depot (TPD). A database is designed for the TPD to be linked by Internet network with other production depots and this is called International Network (IN). This leads to the International Network Corporation (INC) enabling globalisation of manufacturing activities at any geographical location to be integrated into one system. Individual TPDs can then be integrated together to become a global partner of the multi-national corporation. Globalisation in the context of INC means that the product or different part of the product can be designed, tested, analysed, and manufactured in different TPD at different sites worldwide for a number of reasons, such as technology and resources available in a particular TPD.

An INC may have various design experts, machines and equipment located around the world. Appropriate decision has to be taken to allocate different tasks to a suitable TPD in order to maximise the utilisation of resources. In order to manage all these facilities effectively and to handle its policy making and production planning, an INC needs a communication network that interconnect its multiple manufacturing plants and sales offices as well as other facilities. Considering this, an attempt has been made to design and develop IN making use of the advanced technology in Internet and multimedia.

Effective productivity depends on time to market, product costs, market share, and quality. The IN is a systematic tool that embraces customers, suppliers; distributors, powerful information infrastructure, and effective use of modern technology leading to every success of a INC.

Globalisation of manufacturing requires efficient transfer of manufacturing information among various regions. Therefore, a technique called Telepresence Teaching and Learning (TPTL) is designed and implemented to change the current education process. Individual TPD in one part of the world can control off shore manufacturing and at the same time viewing the animated manufacturing processes on line via the IN.

This is like making products in house without going to the distance site. Similarly, students in one location will be able to control the FMS and even the robot located remotely as well as enjoying the animated presentation. The system provides web site as an interface between students and the TPD incorporated with central network server and allows students at a distant site to operate the machines through Internet.

LITERATURE REVIEW

Video conferencing is the combination of dedicated audio, and communications networking technology for real time interaction [3]. Types of video conferencing include room based systems and desk top video conferencing. Room based systems allow groups of people in a room setting to communicate with other groups of people. Desktop video conferencing combines personal computing with audio, video, and communications technologies to provide real-time interaction from a typical personal computer, and the interaction embodies communications between groups of people.

In education, numerous researchers [4,5,6,7] have evaluated video conferencing system (VCS) to be effective and efficient as means of imparting instruction and information to geographically dispersed groups of people. It allows students to enhance interaction at distant site. Using the system for educational delivery was found to be flexible and exchange of ideas and knowledge is greatly improved and learning experience is substantially enhanced.

Coventry [8] reported that video conferencing has great potential for learning in higher education. The potential lies in creating greater opportunity for dialogue which facilitates more effective learning than working in isolation. Dialogue may be between tutors and learners or amongst learners.

In view of the development of Internet, applications of VCS are associated with the education in Internet environment. West Virginia Educational Network [9] was created to link up classes for higher education. Perrone [10] presents WebQuest, which is a system combining the WWW with the notion of an interactive quest game. Players of the game answer questions to acquire important objects needed to solve the quest.

Wong et al. [11] used the concept of dynamic documents to render on a WWW browser, a sequence of multimedia scenarios, having objects of types such as audio, image, plain text, HTML,

document and animation. It allowed the user to interactively test and compose such a presentation, using Netscape Navigator to collect multimedia resources from the WWW. A presentation database stores the presentation and serves as a convenient repository for users to access.

The current Internet is widely accepted by users for communication world-wide. The Global Internet is now being used to manage networks as well as user and application interaction in a local and international environment. The video must be integrated with the Internet/Intranet and organised to enhance information processes such as, email services,

SET-UP OF THE TELE-OPERATION MANUFACTURING SYSTEM LABORATORY (TMSL)

The configuration of the tele-operation manufacturing system is shown in Fig. 1. The main components in this system include a web server and a database server in the host computer. The web pages in the web-sever provide an interactive interfaces to the users. The web-pages allows users to select various combination of product design, orders for product and animated images on product design. In addition, the users can view the operation of manufacturing processes and make dialogue with the local site through internet or VC system. The later features are useful for vocational training globally.

The web-pages are front-end database application, which allow users to select and submit their requests into the host computer. In the host computer, which includes a SQL database server, whenever there is a request being submitted through the Internet or Intranet, the data will be transmitted into the SQL database server and stored up automatically. A visual basic control program run on a local computer will communicate to the host computer. The local computer connects to an ABB robot controller through a robcomm software. The robcomm software is a TCP/IP communication software which set up the communication between the ABB robot and the local computer. The entire manufacturing system can be controlled and monitored by an external computer via this TCP/IP communication interface.

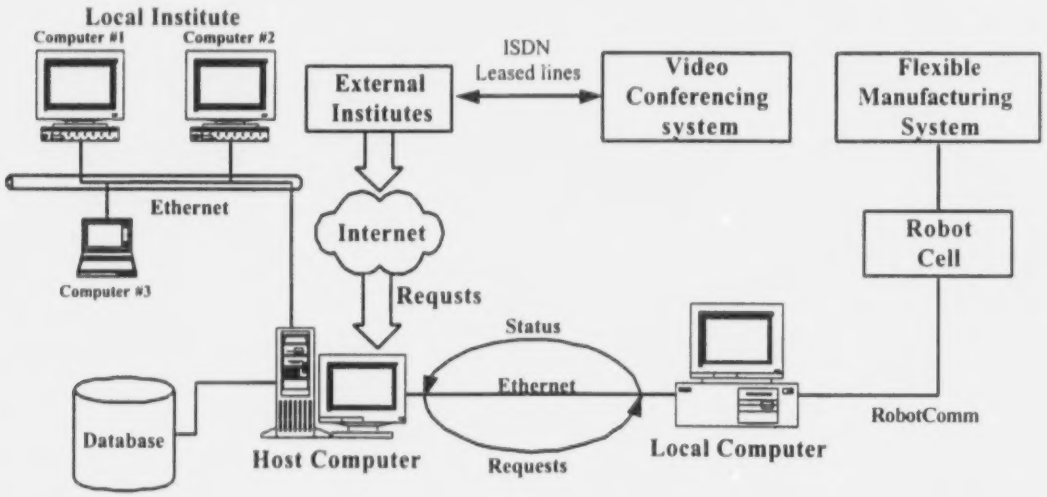

Fig.1 Tele-operation Manufacturing System

In addition to the control aspects, the tele-operation system also includes a monitoring system. The monitoring system is divided into two parts. The first part installs a number of web cameras to monitor the operation of the manufacturing system. The local computer can communicate with other computer via Internet or intranet using Microsoft Netmeeting. With this setting, the local computer can make a call with a remote computer and communication can be established. Both video, audio, file transfer and software sharing activities can be made. Due to band width of the existing network, this configuration performs satisfactory only in the host institute within the local area network (LAN). However, it can still provide an useful on-line training to our students. For example, staff in classrooms or laboratories can link to the TMSL for on line demonstration and discussion via the campus network.

In order to speed up the communication, a video conferencing system with three 128k ISDN leased lines is adopted to improve the speed of video and audio images. External institutes can make a call to the VC system so that they can communicate with the lecturing staff in the laboratory. With this set up, the frame rate can be up to 30 frames/second which is acceptable quality for audio-visual images.

The tele-operation manufacturing system laboratory (TMSL) uses the video conferencing system (VCS) that facilitates collaboration, interaction and information interchange among various systems. It also permits virtual meeting with voice, graphic text, and video capabilities. It is a powerful tool for effective dissemination of knowledge globally.

Students can gain experience as a result of attending the training using VC system via TMSL as well as through monitoring other depot's manufacturing processes. They can have a better insight for improving productivity with international collaboration. They can understand how multi-disciplinary teams and resources located worldwide could be managed as well as data can be shared amongst teams from different domain.

TMSL not only offers the ability to integrate audio experience directly with text, but also adds the power of interactivity. This learning system generates an active, and self-directed learning environment for students. The system not only improves the process of teaching and learning, but also provides new tools and technology that promote remote learning.

CONCLUSION

An engineer on one side of the world will be able to control the FMS and the robot cell located remotely. He can work on a common manufacturing activity with another remote engineer collaboratively and interactively through the implemented development. Geographical barriers that defer the operations of International Network Corporation (INC) will be eliminated. With the installation of video conferencing system, photo-realistic images can be produced which provides a convincing audio and visual presentation for design selection, manufacturing and assembly processes. People can view all these virtual and animated display worldwide.

The use of telepresence teaching and learning (TPTL) improves quality of teaching by delivering knowledge globally to students. Students, at a distant site, can acquire skills and production methods on a PC and concurrently access necessary data and information (Support remote training and on line operation training to students). Students can overcome the barriers of time, distance, and costs to share information and knowledge on line as well as in real time to achieve the best value from education. Instant instructional feedback is possible, as students are able to make global criticism at any geographical location.

Use of TPTL may result in less teaching manpower and teachers can use more time to carry out research or to receiving life long training to keep abreast of latest technology.

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WORLDWIDE TECHNOLOGY TREND OF ELECTRONICS PRODUCTS

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Abstract: Electronics products have undergone much significant advancement in recent years. Although the development trends have primarily been determined by the developed nations such as United States, Japan and the European countries, these trends have been largely driven by many principal drivers. These principal drivers can broadly be classified in terms of users, technologies and regulatory changes. This paper briefly examines these drivers as well as the technology and product trends in the sectors of telecommunications, consumer electronics and information technology products. Its implication to the training and skill development requirements for Hong Kong will also be examined.

DRIVERS FOR CHANGES

Many new types of electronics products have emerged in the past few years offering innovative features that are made possible by recent advances in new digital technologies. In order to understand the way that new electronics products have evolved and developed in the past few years, it is prudent to examine the principal drivers for these changes. These principal drivers can broadly be classified in terms of users, technologies and regulatory changes. The changes in user requirements and behaviour have led to the development of many new technologies that in turn create new markets. Regulation changes, such as the introduction of stringent rules, or deregulation, can lead to incentives to develop new technologies or emergence of new products, or both.

In terms of new technologies, it can be broadly divided into five fundamental technology drivers:

1. The continuation of processing power increase following Moore's law
2. Increasing emphasis of Intellectual Property on silicon
3. Transmission technology in speed and connectivity
4. Storage technology in solid states and magnetic media
5. Electronics packaging technology in miniature products

These fundamental technology drivers will continue to dictate the development and trend of the electronics product in the future and by understanding these technology drivers one could better prepare for the technology trend in the coming years.

As a result of these principal drivers, the innovative electronics products are continuing to emerge heading for the following directions:

1. Digitalisation
2. Convergence
3. Connectivity
4. Miniaturisation
5. Standardisation

These directions are the attributes of new electronics particularly for a connected society. The pace of the development of these products in different countries will be determined largely by the pace at which the information infrastructure is established. Currently, Internet provides a means by which individuals can make use of innovative electronics products to work more efficiently, to be entertained, to communicate better, and to conduct their day to day personal business.

TECHNOLOGY AND PRODUCT TRENDS

Telecommunications Sector

This sector will play a major role in enabling the connected society to be more closely connected. The key areas for development in this sector in the next few years will be in wireless data communications and home applications. Figure 1 shows the major product trend of the telecommunications sector for a number of major product types. The general direction of these product trends are in enabling users to get connected to the Internet while they are on the move, in the office or at home. Some of these products are the result of convergence of the sectors of Information Technology and Telecommunications. Internet Appliances are the prime examples of this type of products.

With the looming introduction of GPRS (General Packet Radio Service), EDGE (Enhanced Data Rate for Global Evolution) and 3G (Third Generation Mobile Phone) over the next three years, users will be able to be continuously connected to the Internet while they are out of their office. With the packet based GPRS, to be available in Hong Kong in the later half of 2000, users will be able to be connected to the Internet continuously without the need to pay the hefty fee as with the current circuit switched GSM data services. The GSM service is currently charging on the time use

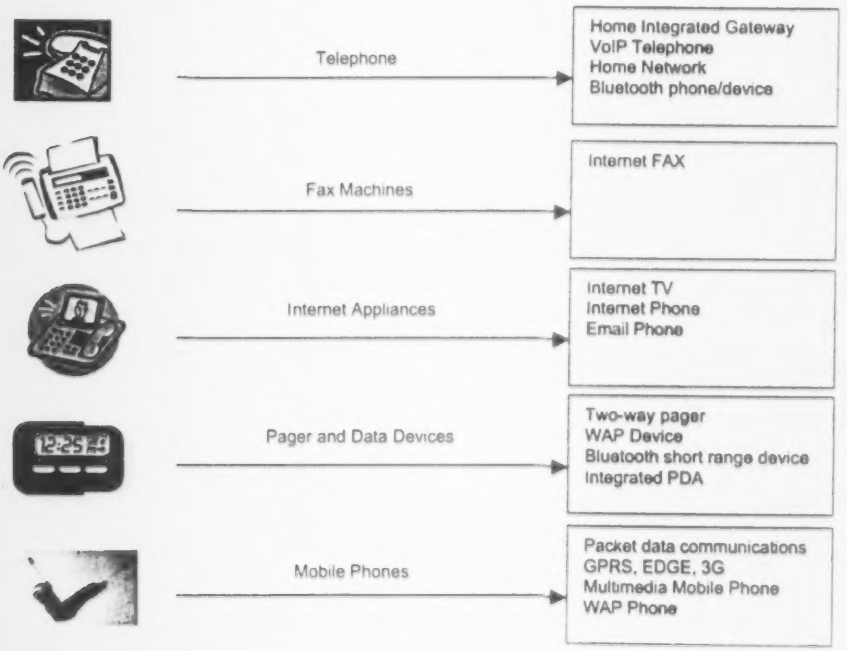

Figure 1: Product Trend of the Telecommunications Sector

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during the entire connection session while GPRS only charges for the bandwidth used in the transmission of data, regardless of the connection time. While GPRS will eventually increase the current connection speed from 9.6 Kbps to 114 Kbps, EDGE technology, to be available in 2001, will push the transmission speed up to 384 Kbps. With the likely increase in user demands on the bandwidth, 3G will offer broad band wireless communications of up to 2 Mbps. Products which are 3G capable are expected to come on to the market in 2002.

On the other hand, Bluetooth will not only bring wireless network connection to the office but also to the home as well. The low cost expected of Bluetooth components will allow many household products to be, "Bluetooth enabled". While inside the home, a home network can be realised by a Bluetooth network, the connection out of the home will also expect to undergo a fundamental change. Home gateway will play a major role. The connection out of normal home will gradually migrate from a normal telephone circuit switched connection to a packet switched data connection. Then, voice, data, Internet, cable TV, Interactive TV and fax lines will all be integrated into one single connection to possible the "Next Generation Network (NGN)" which is expected to replace the current giant telephone exchange networks.

The mobile phone will play a more important role in the connected society than a mere voice-based device. Already, there is the first version of WAP phones on the market which is only the first of this type of mobile phone based data terminal devices in the market. With the increase in available bandwidth with the new GPRS, 3G type technology, mobile phones will have multimedia features allowing not only voice but also video and other types of data to be communicated.

Consumer Electronics Sector

Digitalisation has been a major technology trend of consumer electronics for the past years and it is going to be a prevailing trend for the years to come. Figure 2 shows the major product trend of the consumer electronics sector for a number of major product types. Digitalisation allows more functionality and processing to be performed in the data. For example in video recording, products, such as DVD (Digital Video Disk) players, play back many hours of video in a single disk through the use of compression technology. The compression and decompression technology requires the use of specialised digital signal processor chip to perform the necessary operations. As noted in previous section, intellectual property on-a-silicon is one of the main technology driver for this trend. With the continuous increase in the processing power of DSP and ASIC (Moore's law), more versatile and computational intensive features can be implemented. Many types of consumer products are no longer standalone products. The increase in processing power of the ASIC and processor allows these products to have built in functions to connect to the Internet.

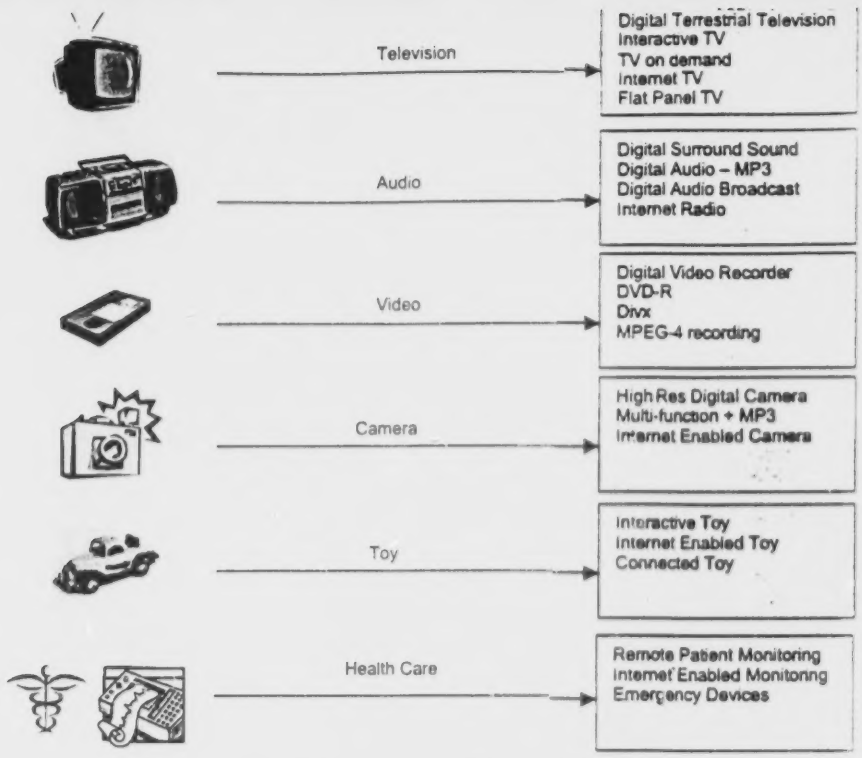

Figure 2: Product Trend of the Consumer Electronics Sector

Indeed, connectivity to the Internet is another major technology trend of new types of consumer electronics products. Products such as digital still camera, MP3 players, electronics toy and games, radios and televisions all have their Internet enabled versions. Digital still cameras will have built in TCP/IP stack and modems such that it is able to dial up to the Internet and upload or email certainly pictures to a destination email address. MP3 players now longer will require the PC to download songs while they will have their own WEB browser built-in such that it is able to download songs from the Internet. Already, there are many video games that would make use of the Internet to achieve multi-player operations. ReplayTV and TiVo provide the service in the United States making use of the Internet to regularly update television-programming information and provide the user with a customised on-screen channel guide to make recording of video programs a one-touch operation.

Some products that emerge in recent years are the results of the convergence of the traditional sectors of Consumer Electronics, Information Technology and Telecommunications. For these products, with most of them with the ability to be connected to the Internet, they can no longer be clearly classified into either of the three traditional sectors. In effect, the growing trend is that the barriers between these traditional sectors are breaking down and many new products are expected to emerge. Some classify these products as convergence products.

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Information Technology Product Sector

The following adjectives will best describe the product trends of this sector: cheaper, faster, feature packed, connected, broad bandwidth, portable and flat. Figure 3 shows the major product trend of the information technology sector for a number of major product types.

Connectivity to the Internet is the essential product and technology trends of the information technology product sector. With the ever increasing use of the Internet, the demands on LAN and connection to the Internet in turn become a key driver for the growth in this industry. For local area network, the technology trend will head for two separate directions. For heavy traffic LAN, gigabyte or even ten-gigabyte networks will couple with optical fibres connected directly to the computer. The higher transmission speed will imply heavier reliance on optical communications and the proliferation of optical electronics closer to the client end. For most types of LAN, cable replacement Bluetooth technology will be the prevailing trend of wireless LAN. With the initial bandwidth of 1 Mbps and low component cost, Bluetooth technology offers integrated services allowing wireless transmission of both voice and data within the office.

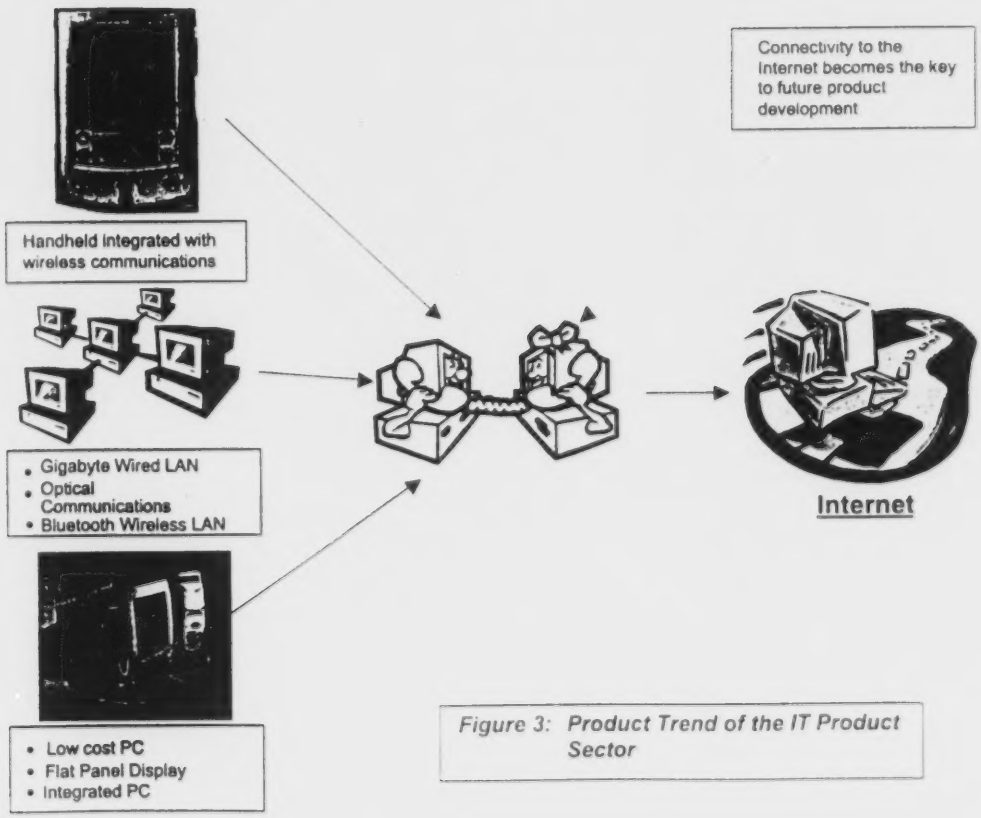
Connectivity to the Internet becomes the key to future product development
Handheld integrated with wireless communications
• Gigabyte Wired LAN
• Optical Communications
• Bluetooth Wireless LAN
Internet
• Low cost PC
• Flat Panel Display
• Integrated PC

Figure 3: Product Trend of the IT Product Sector

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Mobile Computing technology will see significant development in coming years. Wireless data transmission technologies such as GPRS, EDGE and the looming 3G allow handheld computers to be continuously connected. As with the way mobile phones have fundamentally changed the way users communicated by telephones, continuously connected handheld computers will allow users access to the important data in the office. The product trend is this area will be that handheld computer will have built-in wireless data transmission capabilities. First version of this type of handheld units is now available from major vendors such as Palm, Nokia, Ericsson and Motorola. Although many view these first attempts to be too clumsy, vendors will eventually perfect these units through more powerful processors and better packaging technologies.

THE IMPLICATION OF THESE ADVANCES

The five technology directions noted in the first section of this report: Digitalisation, Connectivity, Convergence, Miniaturisation and Standardisation will form the basis for electronics products developed in the next few years with the first two being the major technology trends.

Digitalisation will demand for more powerful processors and versatile algorithms in the development of new products. These new algorithms or intellectual properties will be implemented in the form of ASSP or ASIC where most of the value add of a new product will lie. In the new economy, countries or regions that are able to develop and produce the IP, and subsequently the ASIC, will gain the most from the development of new products. Connectivity to the Internet poises to be the major trend across all three sectors. Following MetCalfe's law, the demand on the network utilisation will increase exponentially with the number of connected parties. The demand on products directly or indirectly related to Internet connectivity will increase significantly. Convergence of traditional sectors of information technology, telecommunications and consumer products will create opportunities for new product ideas.

With these trends being the main focus for technology and product development in the next few years, the implication for Hong Kong can be summarised in two major factors: human resources training and infra-structural support.

With the stronger emphasis on IP development and its implementation as ASIC or ASSP, Hong Kong as yet do not have sufficient infra-structural support in terms of their design and fabrication. Most electronics manufacturers in Hong Kong are system integrators with most major components such as processors, display and memory chips imported from overseas. The fact that Hong Kong manufacturers are merely doing OEM or ODM points to a danger that Hong Kong will lack behind in the new economy where IP is the main treasure. Complex IP (intellectual property) in algorithms and product functions is developed as full custom ASICs and/or firmware into silicon chips. IP on silicon has become the highest value added components in a product, thus allowing the originator to command the largest share of profits. The Silicon Valley phenomenon, then, should continue with more innovations and profits being realised at the chip level. The business prospect of product assemblers—as in Hong Kong—remains weak.

In terms of training, in order to compete with overseas competitors, there will be significantly more demands on skills such as digital electronics engineers, embedded software programmers, ASIC designers, electronics manufacturing and packaging engineers and RF engineers particularly for those having the skills and experience in the high frequency area (above 2 GHz).

THE IMPLICATION OF ADVANCES IN WIRELESS DATA COMMUNICATIONS ON E-COMMERCE

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Abstract: The way we conduct our day to day business has undergone fundamental changes over the past ten years. With the emergence of Internet that links the world together, users have put a lot more emphasis on communicating through the electronics media such as email and fax. We now seldom write to each other through letters but rather we communicate more often through emails or even ICQ! With the imminent changes in the wireless data communications, the e-revolution that a lot of us are still trying hard to manage will extend from our desktop on to our hands. Internet connection will no longer be desk bound but will be extended to users who will be connected everywhere, all the time. This paper briefly examines the emerging technologies in the wireless data communications area and their effect on e-Commerce. Its implication to the training and skill development requirements for Hong Kong will also be examined.

FUNDAMENTAL CHANGES

Breaking out of the desktop

Together with Internet, e-Commerce has fundamentally changed the behaviour of many people and the way that many companies conducting their day to day business. The drivers for growth in the use of e-Commerce are:

1. the availability of better information infrastructure
2. the improvement in data security and integrity technology
3. innovative e-Commerce business concept
4. the exponential increase in network utilisation and its relationship to the degree of connectivity (MetCalfe's law)

With the increasing use of e-Commerce in B2C and B2B operations, the demand from the users, in terms of features, speed, ease of use, variety of products and logistic, on e-Commerce will only increase. Furthermore, with the advances in wired and wireless broad band data communications, the "shopping experience" in doing e-Commerce will only be improving continually.

Currently, e-Commerce experience is mainly desk bound. Users must access the Internet or Intranet through their desktop computers. With the significant advances in wireless data communications in the next few years, this will be changed. The availability of packet switched, continuously connected wireless communications regime, the circle of connectivity will be finally completed with users being able to be connected where-ever, whenever they require to.

Currently, connectivity to the Internet is mainly through wired lines. For most users, the connection will mainly be through desktop modems or local area networks. The technology trend (Figure 1) in the wired connection will mainly be towards higher bandwidth through the use of fibre optics. In terms of local area networks, gigabyte LAN or even 10-gigabyte LAN will help to ease the congestion in the ever increasing network traffic for large corporations.

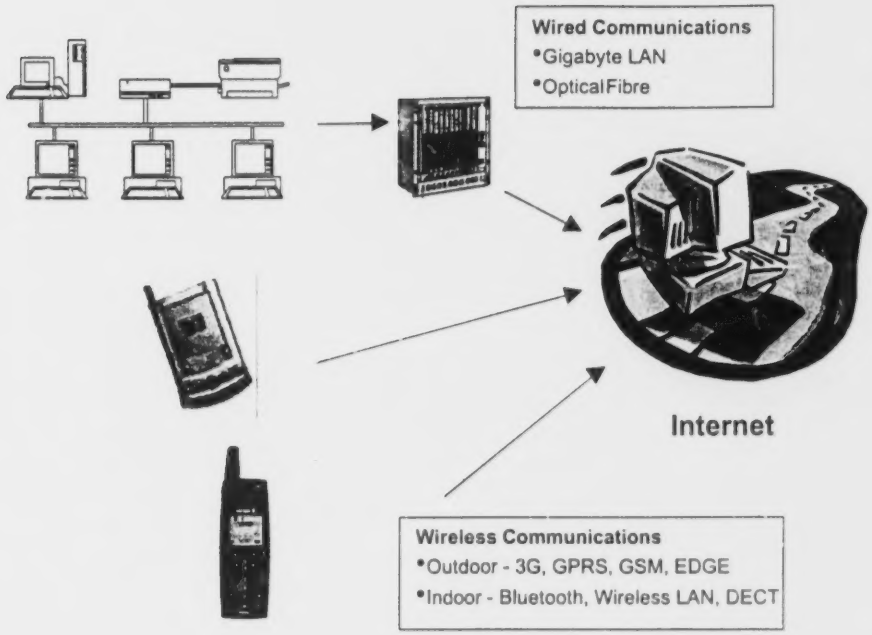

Figure 1: Advances in Connectivity to the Internet

GPRS, EDGE, 3G

For wireless data communications, the trends will be heading towards digital, packet switched broad band communications. For outdoor, circuit switched GSM based narrow band data communications will be superseded by GPRS (General Packet Radio Service) packet switched technology. Through the progress from EDGE (Enhanced Data rate for Global Evolution) and 3G, the bandwidth of wireless communications will increase significantly from the current 9.6 Kbps up to 2 Mbps in the next two to three years. For 3G, Third Generation Mobile Telecommunications, the first commercial system will be deployed in Japan and Europe in 2002. With 3G, users will be able to access all kinds of digital information such as music, photos, video, television, while they are on the move, anywhere. In the interim, GPRS (General Packet Radio Service) will provide "always connected" wireless data network access of up to 100 K bit/s while EDGE (Enhanced Data Rates for Global Evolution) will further boost the data speeds allowing video and mobile multimedia applications with data rates as high as 384 K bit/s. GPRS will be available in Hong Kong by the end of 2000 while EDGE will be available next year (Figure 2).

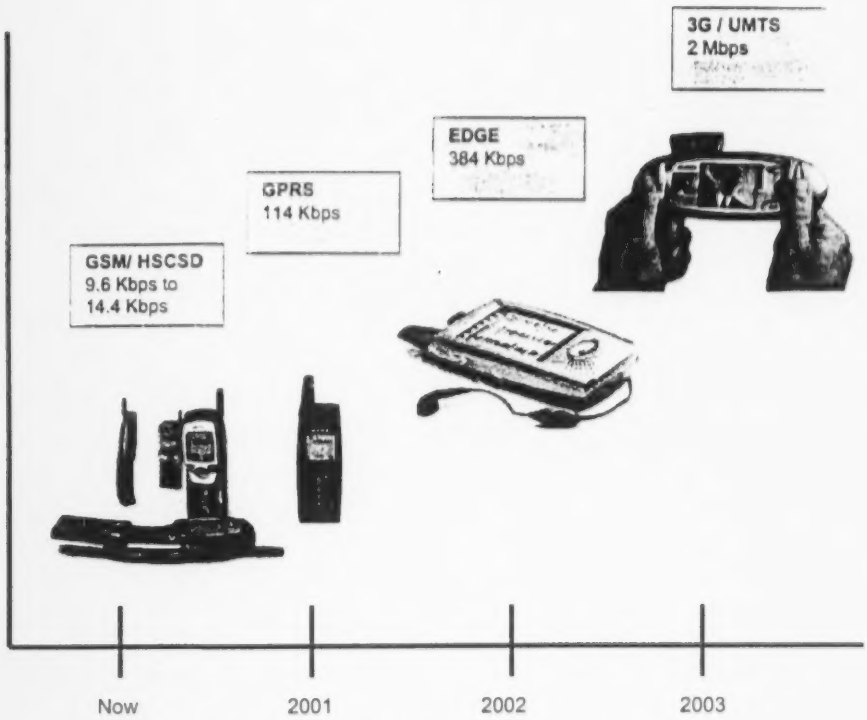

Figure 2: Wireless Data Communications Development

Circuit Switched and Packet Switched

The advantages of packet switched wireless network over the current circuit switched networks (Figure 3) are that firstly, it will be cheaper for data communications. As it is mainly developed for voice call functions, a circuit switched network is charging on a time basis, regardless of whether data is transmitted over the link for a data communication connection. So, for data connection purposes such as WEB browsing or even WAP browsing, the connection charge will be costly even for most of connection time, the link could be in an idle state. For a packet switched network, the charge involved should be much cheaper than a circuit switched network for such a network would be only charging for the bandwidth use rather than for the time used. Secondly, a packet switched network will have better control on data integrity. For a packet switched data transmission scheme, data are broken into many small packets and transmitted over the air. Data can be re-transmitted if they are found missing or lost over the transmission channel. Third, a packet switched data network will allow handheld or mobile devices to be continuously connected without the penalty of heavy connection charges. A packet switched network will not require the extra time to get a connection as in the case of the circuit switched network right now.

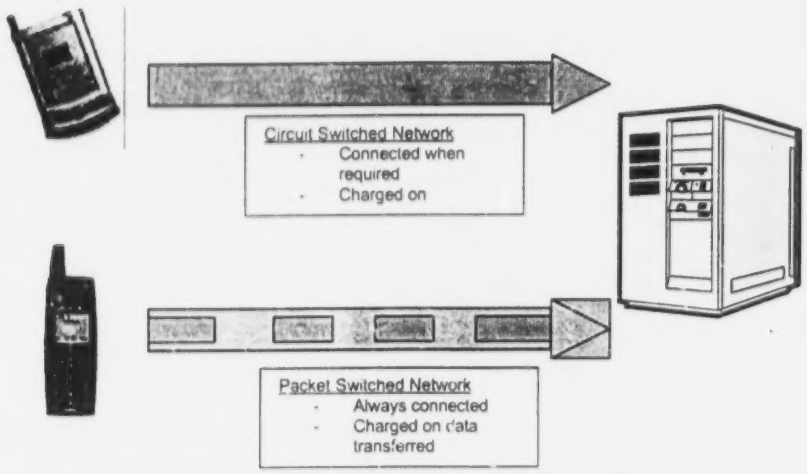

Figure 3: Switched Wireless Data Network

Bluetooth

For indoor, Bluetooth will become the prevailing trend for both wireless short range data and voice communications in the next few years. Bluetooth is the result of development effort of both the telecommunications and computer industries for the past few years and it aims to provide an effortless service for both home, mobile and business users with a low-cost and low-power radio based cable replacement technology. It operates in a unified frequency ISM band of 2.4 GHz. The initial cost for a Bluetooth module will be around US$20 but the increase in volume will eventually see the cost of such modules to drop to US$5. It has a gross data rate up to 1 Mbps with second generation devices going up to 2 Mbps. The integrated voice and data service will not only be the emerging standard for wireless LAN but the low cost of Bluetooth components will drive the increasing use of Bluetooth enabled devices at home as well. The low-power Bluetooth radio module is designed to be built into mobile phones, mobile computers, home appliances, wireless LAN modules, computer peripherals, and network gateways.

The performance of Bluetooth devices is very flexible and robust because the Bluetooth protocol features a range of flexible packet types. Further, using a frequency hop scheme allows Bluetooth devices to communicate in high data rate even in the presence of severe interference. The operating range is set at 10 metres which is optimised for power consumption and indoors short range usage.

THE IMPLICATION OF THESE ADVANCES

With these imminent advances in wireless data communications technology, the entire concept of the e-Commerce system will be migrating to a mobile commerce or ***m-Commerce*** system. It will be a system that allows users to perform business transactions, purchases, accesses to their data on the home server and even video conferencing, anywhere, any time. In the same way that cellular phones have fundamentally changed the way we communicate both in our personal life and in business, m-Commerce will take this one step further. Such development will provide strong

opportunities for both the fields of Information Technology and Electronics and it further demonstrates the growing convergence of the two important fields in terms of opportunities, technology and market.

Wireless data communications will be the main focus for technology and product development in the next few years. The implication for Hong Kong in terms of training and development is that there will be significantly more demands on skills such as RF engineers particularly for those having the skills and experience in the high frequency area (above 2 GHz). As there are a lot more opportunities in new, small wireless devices utilising wireless technology such as Bluetooth, testing equipment and compliance technology will also need to be upgraded to cope with the increase demands.

Further, with the increase demands on m-Commerce and wireless devices, it can be foreseen that the demands on software engineers with specialities on both application software development as well as embedded software development will be significantly increased. In terms of embedded software development, software engineers will be contented no longer with only MCU assembly type programming but in a more structured real time system type programming.

In conclusion, the imminent revolution in wireless data communications development and m-Commerce will present a lot of opportunities for Hong Kong. Being in the forefront in the application and usage of telecommunications products in the world, Hong Kong is in a strong position to ride on this next wave of IT revolution. Suitable engineers, both in RF, hardware and software, need to be trained in order to cope with the significant increase in their demand, or else, the opportunities will be heading elsewhere.

NEW ROLES OF VOCATIONAL EDUCATION AND VOCATIONAL TEACHERS FOR TECHNOLOGICAL CHANGE: A CASE STUDY OF THE HONG KONG INSTITUTE OF VOCATIONAL EDUCATION

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Abstract: This study aims to identify the recent changes happened in the Hong Kong Institute of Vocational Education (IVE) and to investigate the new roles of vocational teachers for technological changes, in particular, Information Technology (IT). A number of recommendations were made to vocational teachers so that they can make significant changes to meet the demands and challenges brought by these changes.

BACKGROUND

The world is now moving into the 21st century with a major shift from the traditional era of industrial economy into the knowledge-based economy (Bate, 1999). With its economy undergoing structural changes, Hong Kong is moving from a 'labour intensive' industrial society into a knowledge-based society and will become a regional information and transport hub in the Asia Pacific region. To achieve this, our new generation is expected to

> take the initiative to think, question, communicate, collaborate, participate, experiment and explore so as to construct knowledge, develop multiple abilities and enhance their personal quality, thereby laying a sound foundation for life, work and lifelong learning (Education Commission, 2000, p. 125).

With such shift and expectations, the functions and roles of education have to be changed in order to cope with such changes. The promotion of life-long learning and the applications of technology, IT in particular, marks the fundamental changes in education in Hong Kong that affect every stakeholder in the system (Hong Kong Government, 1999).

Like any sector of education in Hong Kong, vocational education has also been undergoing rapid changes. Vocational education is no longer simply serving as a sifter of manpower nor a provider of technical qualifications, but a motivator of lifelong and student-centered learning. The Hong Kong Institute of Vocational Education[1] (IVE), the major vocational education provider in Hong Kong, has introduced significant changes in its operational structures and management systems (Segal Quince Wicksteed Limited, 1996). Among these changes, the development of key academic initiatives to support and enhance the quality of teachers has the most significant impact on IVE

[1] In 1999, the IVE provided more than 62,000 full-time and part-time places to students age from 16 and up from post secondary three to sub-degree level

teachers. Such initiatives, coupled with the new demand on teachers as proposed by the Hong Kong Government, have brought new challenges to IVE teachers.

Given the new challenges, the roles of teachers as well as skills demand on them will be changed accordingly. Teachers, as the most significant stakeholders in such process, will respectively change from an information provider to facilitator and mentor of student development. As Delors (1996) remarks,

> the need for change, from narrow nationalism to universalism, from ethnic and cultural prejudice to tolerance, understanding and pluralism, from autocracy to democracy in its various manifestations, and from a technologically divided world where high technology is the privilege of the few to a technologically united world, places enormous responsibilities on teachers who participate in the moulding of the characters and minds of the new generation (p. 141).

This paper studies the recent changes happened in IVE and attempts:

1) to identify the areas and reasons for change in the IVE; and
2) to explore the new roles of vocational teachers in the new millennium and the IT skill requirements demand on them, given the changes identified.

METHODS OF STUDY

In order to explore new roles of vocational education and vocational teachers for technological change, three main methods: questionnaire survey; personal interview; and document analysis, were used to gather information for this study.

Questionnaire Survey

Two questionnaire surveys were conducted in which one was with IVE students and the other was with IVE teachers. The student survey was on students' perception on an ideal learning environment and their applications of IT in learning, which affects the new role of IVE teachers. Three hundred first year students from six departments[2] of two IVE campuses participated in this survey. This questionnaire survey included 20 questions which asked students' perception of an ideal learning environment for two basic approaches of learning, i.e. the surface approach and deep approach as advocated by (Marton & Saljo, 1984). Students are requested to choose five requirements as their ideal learning environment among 20 questions, subsequently, questions with higher scores were regarded as the new expectation of students in their learning and new roles of teachers in their teaching (see Appendix 1 for details of questions).

The teacher survey was on teachers' competencies in using IT for teaching in IVE. One hundred and fifty teachers from two IVE campuses were given a questionnaire which required them to identify their IT competencies at three different levels [3] (see Appendices 2 & 3 (a) for details of the competencies). Consequently, a returned questionnaire with a high score indicates that the teacher has a high competency in IT skills and knowledge.

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[2] Departments of Business Administration, Electronic and Information Engineering, Printing, Applied Science, Computing and Design

[3] Questions 1 to 5, 6 to 13, and 14 to 21 represent the awareness level, application level, and advanced level of IT competencies of IVE teachers respectively.

Personal Interview

Structured personal interviews were conducted with 20 students from IVE's Kwun Tong campus and 25 teachers of two IVE campuses to gather opinions about the applications of IT in learning and the considerations of IT applications in teaching accordingly. The questions for these interviews are shown in Appendices 3 (b) & (c) for details.

Document Analysis

Internal documents were examined in order to find out the progress of applying IT in teaching and learning in IVE.

FINDINGS AND IMPLICATIONS

Student Survey

Among 300 delivered questionnaires, 238 completed questionnaires were received, representing a response rate of 79%. In the survey, over 29% of students: preferred teachers to be an explainer; entertainer and friend; liked to share with classmates and teachers; preferred for autonomy in learning; were eager to use lots of different learning methods; intended to understand; were more active in independent learning but de-emphasized the rote learning. In other words, they were seeking for higher level of learning - the deep approach and student-centered learning. Nevertheless, about 17% of students sought the surface approach of learning: preferred teachers to give effective notes and tell right answers as the learning aims. (The detailed analysis was also shown in Appendix 1).

Teacher Survey

Among 150 questionnaires delivered, 91 completed questionnaire were received, representing a response rate of 60%. Concerning the IT competencies IVE teachers achieved, it was revealed that over 80% of them were at the awareness level; over 39% of them were at the application level and below 18% of them were at the advanced level regarding their IT competence. A breakdown of the response was also shown in Appendix 2. It was reflected that most teachers achieved the basic skills and could apply these skills in their teaching.

Teachers also adopted a positive attitude to face the challenge of using IT in teaching and had already recognized the need to update and re-conceptualize their values of different IT competencies. These competencies were based upon the new directions and challenges that were significant to assist them to fulfill their new roles. However, teachers indicated that training programs offered to them by IVE should be strengthened to develop their IT knowledge to a higher level, e.g. the application and advanced levels as listed in the specifications of IT competencies for IVE teachers.

Structured Personal Interview with Students

In the interviews, most of the students preferred to have a flexible class where they could explore independent learning options and they were also comfortable with applying IT in their flexible learning. Most of the interviewees agreed that applications of IT in learning can assist them to learn more flexibly and effectively. They pointed out many advantages of applying IT in learning. For example, IT allows them unlimited time, space and format to learn. At the same time, it enables

self-paced learning for students and helps teachers to empower them to have greater control over the learning process.

Furthermore, they use online Web facilities such as WebCT to access the event calendar, learning materials, course assignments and teachers' homepages, where teachers post information about their learning style, assignments, grades and lessons for independent study. This tool also helps them foster team building and enhance communication among diverse groups of classmates. As a result, they develop greater confidence that improve their ability to communicate and work with their classmates.

However, students reflected that the free booking of computer rooms plus the handful of computers in the library could not satisfy their demands. WebCT added extra load onto students because they could only gain access to the materials on the WebCT through the computers in the campus. This was also reflected in the consolidated report on 1999/2000 Student Personal Tutorial Interviews[4]. Some students opined that they were so keen on seeking for competition for a place in a Higher Diploma course[5], therefore, they preferred the traditional way of learning because teachers prepared all notes and took an active role which puts a heavy emphasis on examination-oriented tuition for them. This approach did not require teachers to apply any multimedia or IT to enhance their learning.

Structured Personal Interview with Teachers

Most of the teachers being interviewed agreed that IT in education: was accompanied by the sociological and economical pressure and would transform the way that education to be conducted; and IT enhanced the effectiveness, efficiency and flexibility of teaching and learning. They expected that IT will play an important part to provide professional, as well as causal 'on-line learning communities' in vocational education in the near future. Applying IT in teaching will help them to draw students' attention, arouse funs, break the barriers to communication such as time and distance, and monitor the progress of students.

In addition, IT allows teachers immediate access to up-to-date, diverse and specialist information, speed up the process of research and development and allows greater collaboration between industry and vocational education institutions both nationally and internationally. Nevertheless, teachers stressed that IT may not be suitably applied in all subjects because the conceptual nature or ideas of some subjects are difficult to be 'visualized' with IT. Therefore, the usefulness and suitability of applying IT in teaching different subjects should be reasonably judged in terms of learning objectives, motivation and prior knowledge of the learners.

They were also concerned that they may not have skills to use the latest IT and Internet technology (e.g. video-conference, email, chat-rooms, discussion lists, ICQ, etc) in the tradition or virtual 'classroom', as such innovation requires teachers to have sufficient training and a wide spectrum of skills to be developed. Some teachers pinpointed that most teachers and students were too accustomed to traditional approach of teaching and learning. They suggested that the applications of IT in teaching and learning should be implemented incrementally and IVE should reserve teachers and students enough time to adjust and to adopt.

Many teachers suggested that notebook computers should be widely deployed to teachers and students in the long run. In addition, they urged IVE to grant teachers subsidies to purchase their own personal computer. They also expressed that cooperation among staff of the Computing

[4] It is IVE's policy that an interview will be conducted between a student and her/his personal tutor once a year.

[5] Students are admitted to Diploma course in their first entry to IVE. Depend upon their performance in their first year's study, they may be promoted to the second year of a Diploma course or a Higher Diploma course.

Division, Educational Technology Unit and teachers should be increased in order to make up the deficit in design expertise and create effective, relevant and quality resources to students.

Lastly, teachers reflected that traditional assessment, which may not be compatible with IT, was a barrier to promote student-centred learning. Moreover, IT may not be able to assess the learning process and higher-level learning outcomes, such as innovation, thinking skill, problem solving, etc.

Document Analysis

As reflected in the documents collected hereunder, it was already visible that there has been an organizational change taken place in IVE. Concerning the new roles of IVE teachers, some significant and related initiatives were also made. These include:

1) A major curriculum revamp exercise was conducted by a rationalization of all IVE courses into a new system, which involved the development of a series of new courses across every discipline among each IVE campuses (VTC Annual Report, 1998/99);
2) The provision of an IT training programmes for teachers via the Teaching and Learning Centre (see Appendices 3 (d) & 4 (a) for details);
3) The enhancement of IVE's IT infrastructure (see Appendix 4 (b) for details);
4) The establishment of a Staff Training and Development Scheme

   A total of 40 members of staff received such sponsorship and the total amount reimbursed was around $750,000 in 1999. (see VTC Annual Report, 1998/99 for details)

IMPLICATIONS FOR TEACHERS IN RESPONSE TO NEW EXPECTATIONS AND LEARNING MODE OF STUDENTS

Redefine the New Roles of Teachers

In order to encourage students to develop a deep approach for student-centered learning, teachers should help students to acquire collaborative, technological and problem-solving skills. Teachers may use technology as a 'conceptual environment' in which students acquired and explored. As a result, teachers will help to build up students' independent learning and thinking. To achieve these, as identified in the 'findings section', it is commonly believed that the new roles of IVE teachers will act as facilitators, mentors and models who may share the joy of learning process with students, arouse students' curiosity and initiatives to learn, facilitate students' self-centered and long-life learning and extend educational opportunities and communication opportunities. They should attempt to accomplish the networked outlook and experiences beyond their own institutes in any time frame, develop a new professional culture, and multiply their teaching effects through mutual sharing with other institutes nationally and internationally.

Identify New Skills

For the successfully integration of technology in the overall learning environment, on-going training and support at all levels is essential (Aust & Padmanabhan, 1994). In IVE, a number of IT workshops were provided to IVE teachers to up-date and up-grade their IT competencies. However, teachers do demand more high level IT training, as reported from the 'findings'.

Tailor the Curriculum

Teachers should be given a freer hand to exercise their professional judgment so that they will have more flexibility in refining the curriculum and assessment as well as to arrange lesson time according to students' characteristics and needs. In the long run, IVE has to streamline the work procedure, to reduce teachers' workload and to arrange a flexible teaching time so that teachers can devote more time and efforts to design better curriculum, activities and resources as well as to provide students with a comprehensive learning experience.

Establish Collegiality

Transforming information into quality IT teaching and learning resources demands a vast amount of time and effort. By involving different expertise from different parts of IVE may be more productive. Therefore, a team approach towards resource development will be appropriate. With clearly defined roles and responsibility in the team, different experts will contribute to different areas of resource development in the most effective and efficient way.

Provide Hardware and Software Support

Appropriate support to teachers is essential for teachers to make the most of IT for teaching. With better IT provisions, teacher will be able to prepare better quality teaching resources, to search latest resources and to communicate with students at the time and place which are of most convenient to them and their students.

RECOMMENDATIONS

In order to assist IVE teachers to fulfill their new roles under the constraints and difficulties mentioned by teachers and students and to build up an institutional-wide IT pedagogical environment, the following recommendations were made:

1) IT programs provided to IVE teachers should be focused on developing teachers' knowledge to a higher level of skill such as application and advanced level of IT competencies. Training on more up-to-date software and hardware should be incorporated into these programs. Modern pedagogy in using IT to enhance the quality of teaching and learning should be introduced in addition to IT skill training.

2) Besides the HK$176.9M being granted, IVE should continue to seek extra funding to improve its technological infrastructure and support to teaching and learning using IT. To allow teachers to make the most of IT for teaching, i.e. the flexibility of time, pace, place, etc, IVE should provide teachers and students free Internet access at home, up-to-date hardware (e.g. notebook computers) and latest software.

3) A team approach has been proven to be one of the best means towards resource development. Teachers should team up with other experts in IVE, e.g. IT experts from the Computing Division, production professionals from the Educational Technology Units, etc. to develop quality IT resources for their teaching. They may also build up collaboration with other partners from other institutes for better resources and to get fruitful opportunities for curriculum enhancement.

LIMITATIONS

Certain limitations arose in this study. Firstly, the questionnaire survey and the interviews were only conducted in two IVE campuses. Therefore, the sample size was relatively small and thus the results of the study should not be generalised to the whole IVE. Secondly, the criterion of IT competencies for IVE teachers and the questions of student's ideal learning environment designed in the questionnaires might only reflect part of the IT capabilities that some teachers possessed and part of the expectations that the students seek. However, this is only a starting point to study the employment of IT in teaching and learning in vocational education in Hong Kong and we invite readers who are interested in this topic to further investigate and share their experience with us.

CONCLUSION

Change requires new mindsets and attitude from students, teachers and the education institute. To meet the changing nature of student population and a growing percentage of students who have already had a lot of experience with technology and high expectations of the educational institute, IVE must formulate a technology vision in order to realign itself to stay ahead of the trends. Moreover, the institute should review and revise its strategic plan that commits to the provision of high quality vocational education in Hong Kong. As educators, we must be brave to re-examine our traditional assumptions about teaching and learning and re-assure our role as facilitators of knowledge acquisition. At the same time, we should stimulate students to re-think their responsibilities in learning so that they will become independent and life-long learners. At last, but not the least, we should bear in mind that IT is only a tool to facilitate quality learning and teaching. However, the teachers who are willing to equip themselves to meet the challenges which derived from the new roles, showing genuine care to students and committing themselves in teaching, are most valuable to our students and the society.

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Appendix 1

Questionnaires and Summary of Findings in "Student's Ideal Learning Environment"
Questionnaires - (Shatin and Kwun Tong Campuses/Conducted on 31/5/00, 2/6/00 and 5/6/00)

Campus: _____ Department:_____

*(The purpose of this questionnaire is to collect the opinion of students on their ideal learning environment. The information provided will be kept in strictest confidential and used for this purpose only. The followings were modified from **Moore & Fitch Inventory of Learning Preferences**.) Each of us has an ideal learning environment. Think how you learn best. You have 5 check marks ("x") to distribute among 20 questions. Put a check mark in the "x" column next to the statement that best describes your ideal learning **environment**.*

No of Rank.	My Ideal Learning Environment/Question No/No of Votes	% of Choice
1	Would have the lecturer/assistant lecturer who was not just an instructor, but more an explainer, entertainer and friend? (Q.11)/122	51%
2	Would encourage me to learn using lots of different learning methods? (Q.12)/118	49%
3	Would provide a flexible class where I can explore independent learning options? (Q.18)/109	45%
4	Would be where learning is a mutual experience where I contribute to the teaching and learning in class? (Q.8)/95	40%
5	Would be where the lecturers/assistant lecturers doesn't tell me the answers; rather he/she shows me how to find the answers for myself? (Q.7)/87	37%
6	Would provide a classroom atmosphere of exploring and debating new ideas? (Q.13)/78	32%
7	Would be where I can make connections among various subject areas and am encouraged to construct an adequate argument? (Q.20)/76	31%
8	Would provide a workshop or seminar atmosphere so that we can exchange ideas and evaluate our own perspectives on the subject matter? (Q.17)/74	30%
9	Would value my classmates as sources of information, not only as companions? (Q.10)/72	30%
10	Would be a 'free-flowing' class that does not follow a strict outline?(Q.16)/72	30%
11	Would be where I would have a lot of control over the course content and class discussion? (Q.3)/70	29%
12	Would be where I take effective notes on what is presented in class and reproduce that information on tests? (Q.4)/40	17%
13	Would emphasize class discussion but I would expect the lecturers/assistant lecturers to tell the right answer? (Q.5)/36	15%
14	Would have the focus on having the right answers rather than on discussing methods on how to solve the problems? (Q.9)/27	11%
15	Would have the lecturers/assistant lecturers give me all the theory and information I need to know? (Q.2)/27	11%
16	Would include straightforward, not 'tricky' tests, covering only what has been taught and nothing else? (Q.6)/26	10%
17	Would be where I could listen intently to the lecturer/assistant lecturer and not to classmates and peers for answers to questions? (Q.19)/25	10%
18	Would be lectures since I can get the information I need to know most efficiently? (Q.15)/25	10%
19	Would provide assignments with practice everyday applications? (Q.1)/23	9%
20	Would include exams and assessment as part of the learning process? (Q.14)/20	8%

Note: Ranking No 1 to 11 and 12 to 20 represent the "Deep Approach" and "Surface Approach" learning respectively

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Appendix 2

Questionnaires and Summary of the Findings in "Teacher's IT Competence" Questionnaires (Shatin and Kwun Tong Campuses /Conducted on 31/5/00 and 2/6/00)

Campus: _____ Department: _____

(The purpose of this questionnaire is to identify the IT competence of teachers. The information provided will be kept in strictest confidential and used for this purpose only. The followings were modified from Alfred Koo's proforma, namely, an "IT Capability Enhancement Plan" in IT Enhancement Program for IVE teachers)

Enter a **"x"** in the empty boxes to indicate some of your IT competence and leave it blank if you do not know.

Crit. No	*IT Skills- Awareness Level*	*No of Votes/ % of IT Capabilities*
1	Handle computer Operating System	81 (89%)
2	Use local network to transfer/retrieve/save materials and to share them among teachers and/or students	77 (84%)
3	Operate basic computer peripheral equipment to prepare simple teaching materials	88 (96%)
4	Access to WWW with a browser to search, retrieve information & TL resources	85 (93%)
5	Basic understanding of the implications of IT in education	75 (80%)
	IT Skills – Application Level	
6	Prepare course materials (e.g. curriculum documents, lecture notes, lab sheets etc) using a word processor	92 (92%)
7	Use spreadsheet/database application to handle teaching related tasks including course scheduling, student assessment, etc)	74 (81%)
8	Use graphic program to create simple graphics for educational illustrations	54 (70%)
9	Prepare a lecture presentation using presentation software	70 (76%)
10	Use e-mail (with attachment, if necessary) to communicate with colleagues and students	90 (76%)
11	Create text-based web pages to supplement classroom teaching	31 (50%)
12	Apply basic instructional design skills in planning TL materials/activities	47 (51%)
13	Understand the basic concept & principles of web based instructions & a CMDP	36 (39%)
14	Create a multimedia presentation with presentation software	20 (21%)
	IT Skills – Advanced Level	
15	Create a simple interactive program on a specific topic with presentation software and/or authoring tools for student learning	17 (18%)
16	Use asynchronized communications on web including mailing lists, newsgroups and discussion forums to enhance teaching effectiveness	17 (18%)
17	Use synchronized communications on web including chat room, IRC, Netmeeting, etc to enhance teaching effectiveness	7 (7%)
18	Manage a web based course/module using a CMDP	12 (13%)
19	Create a web site for TL purposes	17 (18%)
20	Apply advanced instructional design skills to enhance quality of TL materials	11 (12%)
21	Apply project management skills to develop TL materials with a team of staff	13 (14%)

Note: TL = teaching and learning CMDP = Course Management and Delivery Platform

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Appendix 3 – (a)

Definitions of Three Levels of Teacher's IT Competence

(The IT Enhancement Programme has been designed to match different levels of IT competency with the courses that may be available to IVE teacher.)

Awareness Level

(teachers build up foundation skills and become comfortable using it jargon, and in using general it productivity tools.)

Application Level

(teachers become more knowledgeable about how to select the computer-based information, and to integrate it into their lessons.)

Advanced Level

(teachers become very adept using computers, even too the extent they can author their own multimedia material for use in their classes, and to design and maintain their instructional web sites.)

Appendix 3 – (b)

Questions Used in Structured Personal Interview with Students

1 Do you agree that the application of IT in learning is flexible?

2 Do you agree that the application of IT in learning is effective?

3 Do you agree that the application of IT in learning will help the communication between the teachers and students?

4 What can IT be used in facilitating the learning process? In what aspects?

5 What are the constraints of applying IT in learning?

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Appendix 3 – (c)

Questions Used in Structured Personal Interview with Teachers

1 Do you agree that the integration of IT into education has been accompanied by sociological and economical pressure?

2 Do you agree that IT has the potential to transform the way/method that education is conducted and enhance the effectiveness, efficiency and flexibility of teaching and learning?

3 What are the advantages of applying IT in teaching?

4 What are the limitations of using IT in teaching?

5 What are the considerations of applying IT in teaching?

Appendix 3 – (d)

The Provision of an IT Training Programmes for Teachers via
The Teaching and Learning Centre
(Accumulated Attendance of IT Enhancement Programme)
(May 1999 - February 2000)

Course Name	Attendance
Principles in Using IT for Teaching and Learning	
IT in Teaching and Learning: Fundamental/Educational Issues	115
IT in Teaching and Learning: Design Issues	82
Basic Principles of Web Based Instruction	19
PowerPoint	
Preparing Lecture Presentation with PowerPoint: Basic Skills	101
Power Up Your Presentation with PowerPoint	91
Preparing Interactive Multi Media Lecture Presentation with PowerPoint	94

Appendix 4 – (a)

The Provision of an IT Training Programmes for Teachers via
The Teaching and Learning Centre
(Accumulated Attendance of IT Enhancement Programme – Cont'd)
(May 1999 - February 2000)

Course Name	Attendance	
Web Design/Teaching		
Understanding HTML	11	
Basic Web Page Design for Teaching and Learning	109	
Developing Web Page for Teaching and Learning	73	
Teaching with the WWW	82	
Making Static Web Pages to Delivery Teaching and Learning	7	
Enhancing Communication Using the Campus Network/Web	107	
WebCT#		
Making Use of Course Management & Delivery Platform with WebCT	77	
Building WBI Courses with WebCT	12	198 *
Course Management Using WebCT	5	88 *
Creating On-line Quizzes with WebCT	51	13 *
WebCT in Action	5	10 *
Webpage Building Workshop		28 *
Workshop for Graphics/Photos on the Webs		25 *
	1041	362
Total	**1403**	

including Training the Trainers Programmes

* Course Offered by Educational Technology Unit

Appendix 4 – (b)

The Enhancement of IVE's IT Infrastructure

(I) ***Use of IT for Quality Vocational Education***

For example, additional PCs for students, Web-based teaching and learning service, enhancement of the information technology, remote dial-up and mobile PC access service, video conferencing services, replacement of outmoded IT facilities, increased Internet access, server enhancement, etc.

(II) ***MIS and User Services Enhancement***

For example, enhancement of MIS infrastructure to enhance interface, data warehousing of IVE, Web-based MIS, executive information system, e-mail accounts for all staff, etc.

(III) ***Network Infrastructure Enhancement***

For example, upgrade of Internet facilities with Internet access for all PCs in IVE campuses, enhancement of network security, installation of high speed wide area network connecting the nine IVE campuses and three training centre complexes, and the headquarters, electronic library upgrade, etc.

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THE OCCUPATIONAL SKILL TESTING AND CERTIFICATION SYSTEMS IN HONG KONG

S.P. Fu

Vocational Training Council, Hong Kong

Index : Skill Testing / Competence / Certification System / Recognition

Abstract: For the purpose of setting standards for skilled workers and facilitating the acquisition of recognised qualifications, the Vocational Training Council introduced in 1989 a voluntary trade testing and certification system in various industries. Up to now, the number of trades for skill testing has been increased to 32. Some 24 000 workers have sit for the tests with some 14 000 passing the tests.

The trade test certificates have gained wide recognition by the industries, the government and the public. In February 1998, the scheme has been expanded to cover also the intermediate tradesmen/semi-skilled workers. This paper describes in detail the skill testing and certification system in Hong Kong, including its operating procedures, the past experience and future developments.

1. INTRODUCTION

1.1 In order to continuously improve the competitiveness of its industrial products and services in the world markets, Hong Kong began to adopt a systematic approach to upgrade its occupational skill standards. With this in mind, the Vocational Training Council (VTC), established by the Hong Kong Government in 1982, has put in place a comprehensive system for trade testing and certification of skilled workers.

1.2 To cope with the development needs of industry, the VTC has set up a number of training boards and general committees, which cover the majority of economic sectors in Hong Kong. The membership of the training boards and general committees includes representatives from employers, employers' associations, workers unions, tertiary institutions and relevant government departments, with the majority of members from industry and commerce.

1.3 Since early eighties, the training boards of many industries considered that there was a need to have sets of trade test guidelines for the assessment of skill competence of a craftsman. The trade test guidelines laid down the test formats, skills to be tested, marking schemes, pass criteria, test duration and required facilities for each principal job in the industry. The guidelines enable employers in ascertaining the standard of skills and knowledge attained by their workers as well as provide employers a means of assessing the competence of a candidate for job.

1.4 After some years of operating experience, employers in the industries felt that the standard of skill tests conducted by individual employers varied greatly. To ensure an uniform standard, there should be some authorized organizations such as the VTC to co-ordinate trade tests on an industry-wide basis. In 1989, voluntary trade testing and certification system was set up by VTC for Electricians, Computerized Typesetters and Mechanical Fitters.

2. TRADE TEST

2.1 The objectives of the trade tests are:

(a)to help industry in the selection of workers for skilled jobs;

(b)to facilitate the acquisition of recognized qualifications, in particular, for those who have not gone through any formal training, and enhance the status of skilled workers;

(c)to set the specifications related to standards for skilled workers;

(d)with the agreement of the licensing authorities to facilitate the recognition of skill standards attained for the purpose of licensing; and

(e)to facilitate the establishment of skill hierarchy for career advancement of skilled workers.

2.2 For the purpose of meeting the increasing demand from the industries, the trade testing and certification scheme has been drastically expanded. Up to now, the scheme covers 32 trades. In 1999, some 7 000 applicants sat for trade tests and some 5 000 candidates passed the tests with trade certificates awarded. Statistics on trade tests for craftsmen are at Appendix.

2.3 Each trade test normally consists of 2 parts, a knowledge test in the form of multiple-choice questions and a practical test. Candidates who pass the knowledge test and the practical test, either at the same sitting or at different sittings within a time span of three years will be awarded a trade test certificate. The formats of the trade tests together with syllabuses and examples are published in the trade test guidebooks, which are issued to the candidates during enrollment.

2.4 The design and standards of the trade tests are established by the respective trade testing committees of the training boards. Test questions are set by technical experts and professionals from institutions and industry.

2.5 Before putting into use, the test questions will be tried out by in-services workers with adequate relevant working experience. Based on the trial run results, the trade testing committee will then adjust and fine-tune the test questions, testing facilities, marking schemes and test duration. The testing committee designs sufficient test questions to form a test question bank. The test questions are updated periodically and new questions are added to the test question bank. For each session of trade test, a set of questions will be drawn randomly from the test question bank to form a test paper.

2.6 Advertisements will be placed in the local press to invite applications for trade tests. Applications forms can be cut down from the local press and will also be available free from the Trade Test Registry. Workers can enroll for trade tests by submitting their applications (by hand or by mail) to the Trade Test Registry with a cheque or bank draft to pay the test fee. To attract more workers in the trade to trade tests, the test fee has been set at a very low level. At present, the test fee ranges HK$150 in the case of tests conducted by VTC to a few hundred dollars for tests conducted by the Construction Industry Training Authority (CITA).

2.7 The duration of knowledge tests is normally 1 hour and a practical test 1-day. For the practical test, the invigilators carry out in-process assessments and end of assignment assessments objectively according to the approved marking schemes. Candidates will be informed of their test results by post. If a candidate is dissatisfied with the test results, he/she may apply to the training boards for a review of the test results.

2.8 To ensure the validity and practicability of the trade tests, the trade testing committees review the test questions and the trade testing procedures regularly.

2.9 The electrician trade has the largest number of applicants. Trade test certificates for electricians are recognised as one of the qualifications for registering as a licensed worker for Class A electrical works by the Electrical and Mechanical Services Department of the HKSAR Government. Construction trades also attract a lot of applicants. It is mainly due to the specific requirement in the construction and maintenance engineering project contracts imposed by the Works Departments and the Housing Authority of the HKSAR Government requiring their contractors to employ a certain percentage of qualified tradesmen holding either trade certificates, apprenticeship certificates or licensed worker certificates as a measure to ensure the quality of construction work.

3.INTERMEDIATE TRADE TEST

3.1 For the purpose of assuring an adequate supply of technical manpower and setting standards for semi-skilled workers in the construction industry, the CITA and VTC have also put in place an intermediate trade testing scheme since early 1998 for the following fourteen building and civil engineering trades and five electrical and mechanical (E & M) trade skills:

(a) bar bender and finer,
(b) bricklayer,
(c) bamboo scaffolder,
(d) carpenter,
(e) concretor,
(f) general welder,
(g) joiner,
(h) leveller,
(i) marble worker,
(j) metal worker,
(k) painter,
(l) plumber,
(m) plasterer,
(n) tiler,
(o) electrical work,
(p) mechanical fitting,
(q) pipe work (E & M),
(r) sheet metal wok, and
(s) welding (E & M)

The tests for the first fourteen trades are organized by the CITA and the last five E & M trade skills tests are offered by the VTC.

3.2 In June 1999, the intermediate trade tests on pipe work (E & M) was split into 3 modules, namely black steel pipe module, copper pipe module and galvanized-iron pipe module, to meet the demand from fire services engineering workers.

3.3 Those who have passed the tests will have their names put on a register kept by the Labour Department for their priority of employment. Refresher/remedial training courses are also organized by CITA and VTC for workers who fail in the tests to prepare them to re-sit the tests.

3.4 Since the commencement of the intermediate trade tests in January 1998. Some 21 000 applications have been received and 17 000 candidates passed with certificate awarded.

4. RECOGNITION

4.1 Trade test certificates and intermediate trade test certificates are widely recognized by the public, industries and government departments as qualifications for job seeking, job assignments and career development.

4.2 The Works Bureau and Housing Authority of the HKSAR Government have implemented contractual requirements in their works and building contracts to employ a certain minimum percentage of qualified tradesman and intermediate tradesman. Trade test certificate holder is recognized to be a qualified tradesman and intermediate trade test certificate is the sole recognized qualification for a qualified intermediate tradesman. The minimum percentage of the requirements will be increased by stages.

4.3 The trade test certificates of electrician and air-conditioning mechanic (electrical control module) have been recognized by the government for the purpose of registration of Grade A and Grade R (Air-conditioning) electrical workers respectively.

5.FUTURE TREND

5.1 The Works Bureau of the HKSAR Government is in the process of instituting a scheme to register all construction workers. To implement the scheme, the existing trade testing for electrical and mechanical (E&M) trades will be split into modules and also the trade testing scheme will be expanded to cover other construction trades.

5.2 The Electrical and Mechanical Engineering Services Department of HKSAR government is also proposing the following two new schemes:

a. Licensing of vehicle repairers

b. Registration of lift workers

The implementation of scheme (a) will require VTC to substantially expand the existing trade testing facilities for testing vehicle repair workers. Scheme (b) will also require VTC to set up new testing facilities for testing lift workers in the long run.

5.3 In 1999, VTC commissioned a consultancy study on Hong Kong's Apprenticeship and Trade Testing System. One of the consultant's recommendations is that Hong Kong should institute a compulsory trade testing system to assess the skill competence of apprentices who have completed their apprenticeship training. VTC is now actively exploring the practicality of this recommendation.

6.CONCLUSION

6.1 The trade testing and certification system plays a key role in facilitating the acqusition of recognized qualifications and the establishment of skills hierarchy for career development of skilled workers. Much has been done and achieved in Hong Kong's trade testing and certification system in the past decade. However, much remains to be done. With the support given by the Government, employers and the workers, we are convinced that the system could be further developed to benefit not only the local workers but also the economy as a whole.

Appendix

Statistics of Trade Tests for Craftsmen
(from July 1989 to March 2000 Applications)

Industry	Trade	Year of Commencing	Total No. of Applications	Total No. Passed (up to 30.4.2000)	Total No. Attended Test in 1999/2000	Total No. Passed in 1999/2000	Pass Rate
Automobile	Vehicle Body Repairer	1994	263	92	39	17	44%
	Vehicle Electrician	1992	223	51	32	9	28%
	Vehicle Mechanic	1989	1 735	470	106	33	31%
	Vehicle Painter	1996	209	71	29	6	21%
	Sub-total		**2 430**	**684**	**206**	**65**	**32%**
Building & Civil Engineering	Bar Bender and Fixer	1995	1 516	1 148	556	469	84%
	Bricklayer	1993	375	287	117	93	79%
	Bamboo Scaffolder	1995	966	712	373	302	81%
	Carpenter	1993	1 777	1 288	654	559	85%
	Concretor	1995	373	259	85	58	68%
	Drainlayer	1999	55	28	39	28	72%
	General Welder	1996	1 481	897	670	455	68%
	Joiner	1993	1 534	1 017	302	197	65%
	Leveller	1995	1 416	814	452	309	68%
	Marble Worker	1995	190	155	148	131	89%
	Metal Worker	1995	321	238	114	99	87%
	Painter & Decorator	1993	1 835	1 215	498	341	68%
	Plumber	1995	1 837	906	549	301	55%
	Plasterer	1993	1 105	771	471	409	87%
	Steel Welder (replaced by General Welder in 1996)	1995	86	17	-	-	-
	Tiler	1993	744	540	302	243	80%
	Sub-total		**15 611**	**10 292**	**5 330**	**3 994**	**75%**
Electrical & Mechanical Services	Electrician	1989	7 976	2 000	700	219	31%
	Air-cond. (Elect. Control)	1998	25	6	13	4	31%
	Air-cond. (Refrigeration)	1998	42	8	18	1	6%
	Sub-total		**8 043**	**2 014**	**731**	**224**	**31%**
Jewellery	Goldsmith (Fine-gold)	1996	4	2	0	0	-
	Goldsmith (K-gold)	1993	134	72	1	1	100%
	Precious Stone Setter	1994	43	29	1	1	100%
	Sub-total		**181**	**103**	**2**	**2**	**100%**
Machine Shop & Metal Working	Machinist	1993	116	52	4	3	75%
	Mechanical Fitter	1989	505	262	5	5	100%
	Sub-total		**621**	**314**	**9**	**8**	**89%**
Plastics	Mould and Die Maker	1990	494	275	13	6	46%
	Sub-total		**494**	**275**	**13**	**6**	**46%**
Printing	Colour Scanner Operator (replaced in 1995)	1993	5	1	-	-	-
	Offset Litho Platemaker (replaced in 1995)	1993	21	5	-	-	-
	Process Camera Operator (replaced in 1995)	1993	12	2	-	-	-
	Printing Machine Operator	1996	90	28	8	3	38%
	Typesetter (replaced in 1994)	1989	27	15	-	-	-
	Sub-total		**155**	**51**	**8**	**3**	**38%**
Precision Tooling	CNC Lathe Operator	1996	12	3	0	0	-
	CNC Machining Centre Operator	1996	42	16	0	0	-
	CNC Wirecut EDM Operator	1997	19	4	0	0	-
	Sub-total		**73**	**23**	**0**	**0**	-
	Total		**27 608**	**13 756**	**6 299**	**4 302**	**68%**

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DISTANCE AND OPEN LEARNING – WEB-BASED TRAINING (WBT) DEVELOPMENT PROCESS CONSIDERATION

Donna Wing Yiu Lau

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Index: distance Learning, Web-based training, WBT, eLearning, Process

Abstract: Learning is undergoing a revolution as technology provides effective and engaging channels to deliver training to multiple locations when audience can learn, communicate, email, chat, video-conferencing with instructors and others.

This paper highlighted some major fundamental development process someone needs to consider to develop an effective and interactive web-based learning system.

INTRODUCTION

In traditional teaching, the instructor normally stands in front of a classroom filled with 30 or more students. Lectures are being conducted verbally with course materials occasionally transcribed on chalkboards or projected onto a screen. Students usually are frantically copying down words from the screen. A well-planned class may include some question and answer types of discussion. Tests and exams are normally given during class. A portion of class time is normally devoted to review test and exam results. These are things teachers and students in traditional classes do.

Today, the traditional model where teachers stand in front of a class and students sit in a physical classroom at a predefined time is no longer the only teaching and learning environment. The coming of the Web environment brings with it the need for individuals involved in teaching and learning to take their education materials to the next level. The beauty of the Web is that it provides an entirely new context for teaching and learning. It removes the physical and the constraints for instructors as well as learners.

Learning is undergoing a revolution as technology provides effective and engaging channels to deliver training to multiple locations when audience can learn, communicate, email, chat, video-conferencing with instructors and other learners. The increasing use of Web-based training for the delivery of education has brought convenience and flexibility to learners, trainers and the offering institutions. To day, WBT has become important to corporations, small businesses and individuals to develop, deliver and receive training at anytime and from anywhere. The benefit of WBT provides a broad reach of multiple audiences and has high potential customization to address various learning style and needs.

With the rapid growth of Internet technology, multimedia and network bandwidth in recent years, we have experienced a shift of paradigm in doing business, acquire knowledge, pursue education and conduct training. It is undoubly that the community is moving towards a more efficient and effective way to deliver and receive education and training.

Web based training is not just another format for instructor-led or self-paced education. It is a learner centric, interactive, nonlinear, graphical, structural and effective use of the power of multimedia to present knowledge to the community.

However, WBT is not a total replacement of classroom teaching. It is definitely not the solution for every type of training topics. It is appropriate for teaching imparting kinds of knowledge, such as software application, management skills, listening and writing skills, company rules. WBT is also good in providing continuous learning, keeping knowledge current and supplementing instructor-led-courses. Training involves complex physical movement such as operating a truck or driving a car is very difficult to convert to WBT due to this kind of training requires environment and instant feedbacks and mentoring from the instructor.

An effective Web-based training project will not be successful without a team of committed professionals. Therefore the very first thing is to establish a qualified project team to facilitate the design and development of WBT.

WBT Team:

The followings are suggested roles and responsibilities of a basic WBT project team:

a.) A Project Manager - for overseeing the overall team activities and coordination.

b.) A Course Instructor - for developing the course contents and instructional strategies of the course.

c.) An Instructional Designer - for conducting the needs and analysis, choosing the most appropriate forms of web-based training designed lessons and media tools, and developing blueprint.

d.) A Subject Master Expert/Editor - for establishing the needs analysis with the instructional designer and reviewing the goals and accuracy of the subject.

e.) A Legal counsel - for reviewing the design documents to ensure there are no improper use of proprietary information and violations of copyrights, and use of trademarks.

f.) Programmers – for developing web pages and creating scripts.

g.) Multimedia Expert/Graphics Artist - for visual design of the course materials and the Web sites.

h.) Technical Support Staff - for preparing the WBT infrastructure for the delivery of the Web courses and helping the team and learners in their use of the infrastructure for WBT courses.

i.) Learners – can be involved in the beginning and ending of the project. They are expected to provide information and feedbacks of WBT courses.

Development Process Consideration

WBT can be developed with four major phases. They are namely Instructional Design, Course Development, WBT Pilot and Deployment. The purpose of this paper is to explore the needs of these important phases and to discuss how these phases are brought together to make WBT works.

1. Instructional Design Phase:

Instructional Design is the major process of designing the environment, methodology, and resources in addition to developing instructions and strategies for effective learning of course objectives.

The following are the suggested items to be considered for designing instructional materials for WBT:

a.) The target audience of your instructional materials.

b.) The level of knowledge the learners know and don't know.

c.) The level of computer knowledge your learners required to participate in WBT

d.) The goal and objectives of the course.

e.) The expectation of learners wanted to accomplish from the course.

f.) The delivery environment such as network infrastructure and learner workstation requirements.

g.) The determination of training methods. In this design, a single training method or a combination of methods can be used. This includes partial traditional classroom instructions; self-paced workbook exercises and tests; design facility to allow student-to-instructor and student-to-student activities.

h.) The interactions and tools that can provide assistance to learn and communicate with instructors and other learners.

i.) The creation of a detail blueprint for courses and student administration and tracking process and system.

j.) The creation of a detail blueprint on course interactions, feedbacks, and information structures.

k.) The technical limitations such as small bandwidth and differences among browsers that might cause technical problems.

l.) The business limitations such as corporate culture and contractual obligations.

2. Course Development Phase:

Moving classroom courses to WBT environment provides opportunity to re-evaluate the strength and weakness of a course. During the process of either redesigning or converting classroom courses to WBT courses, incremental assessment is crucial to ensure that the development of the course contents and design, the learners' feedbacks as well as the instructional design and supports are sufficient to deliver the Web-based training courses effectively to the audience.

The following are the suggested items to be considered:

a.) Course goal, objectives and contents must be assessed for factual integrity and completeness.

b.) Types of dialogue support.

c.) Teaching and learning strategies such as the forms and frequency of lectures, discussions, mentoring, feedbacks, questions and answers.

d.) Hardware, software, network infrastructure and support.

e.) Forms and frequency of assessment such as tests, exams, group assignments, discussions, vocabulary, examples, practices etc.

f.) The clarity of smoothness of directions, level of interest, and effectiveness of instructions.

3. WBT Pilot Phase:

The purpose of conducting a WBT pilot is to evaluate the technology infrastructure and the effectiveness of the entire instructional design. The results of the pilot can also be used to set the tone for the deployment and support requirements in the implementation phase.

The following are the suggested items to be considered in conducting an effective WBT pilot:

a.) Carefully select a group of accountable learners and support personnel to participate in the pilot.

b.) Clearly define the pilot objectives, tasks, roles and responsibilities to the pilot group.

c.) Define measurable evaluation criteria and tasks.

d.) Maintain open and regular communication with the pilot group and the project team.

e.) Document all sorts of changes, issues and concerns during the pilot phase to ensure that problematic areas can be fine-tuned and improved.

An evaluation process must be in place prior to deployment of WBT. The purpose of the evaluation process is to assess the effectiveness of the WBT system. This process should be able to identify what worked well and where improvements can be made.

The following are suggested WBT course evaluation areas:

a.) Organization of the course contents and the knowledge flow

b.) Clarity of presentation materials

c.) Quality of interactive activities

d.) Adequacy use of multimedia tools

e.) Availability of communication channels, assistance and support

f.) Overall satisfaction with the course

4. Deployment Phase:

Prior to deploying the course on WBT environment, one needs to set the tone for the environment.

The following are suggested items to be considered in implementing WBT:

a.) To set the expectations of the learners in the use of WBT.

b.) To explain to the learners and support staff the roles and responsibilities prior to the deployment.

c.) To state the expectation of response from instructors and technical assistance

d.) To consider a contingency plan for time when the technology is not available and alternatives should be identified for substitution.

e.) To determine the deployment strategies such as limit the number of learner groups, types of WBT courses and where WBT is available for access.

SUMMARY

WBT has gained momentum in the colleges, universities and technical institutes in the recent years globally. Effective WBT requires carefully planned activities, systematic developed processes, manpowers and financial support to implement. Nevertheless with circumspectly concerted efforts of planning, WBT can be applied in many types of training with reasonable amount of time and effort. Learners can gain the flexibility to receive training at anytime and from anywhere.

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INDUSTRY PARTNERSHIP FOR GRADUATION STAGE OF HIGHER VOCATIONAL EDUCATION

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Abstract: Vocational education has been developing rapidly in China these years' Zhejiang University of Technology formulated a flowchart of industry partnership for the graduation stage in the light of characteristics and objectives of vocational education. After three years' experiment in industry partnership, the college has been successful not only in the training of students' ability of comprehensively applying what they learn into their work and in the training of their skill, but also in the preparation for their future employment. In this paper, the author makes a comparison between the traditional practice and the industry partnership in the graduation stage and, after analyzing their characteristics, concludes that the latter can achieve better results through strict management.

INTRODUCTION

Vocational education is a kind of education that aims to provide society with skilled workers for a specific job, to equip students with theories and skills essential to a position so that they will be qualified in their future work. With the development of industrialization, progress of technology and economic globalization and the resulting adjustment in industrial structure, higher vocational education has seen great development.

China drops behind in initiating higher vocational education, but it has seen drastic development in previous years. For example, in Zhejiang province, the number of students admitted to all kinds of vocational universities and colleges is increasing at an annual rate of about 30% since 1994 when the province made experiments in higher vocational education for the first time, 10-15% more than that enrolled in ordinary institutes of higher learning. The number of schools that engage themselves in higher vocational education increases from only ten-odd to more than forty, including all kinds of adult universities and colleges. Higher vocational education, being an important type of higher education in China, has won the approval of and support from people of all walks of life.

Enlightened by overseas advanced experiences in the pedagogical reform and practice on industry partnership, we put forward a program for industry partnership for the graduation stage of higher vocational education. Enterprises- and practice-oriented, the program was aimed to improve students' application ability and was listed into the school's pedagogical reform projects and launched in 1997.

THE PROCESSES OF INDUSTRY PARTNERSHIP FOR GRADUATION STAGE

According to our syllabus for junior college education, graduation work is scheduled in the sixth semester, i.e. the last semester, which lasts about 13-16 weeks. The students have completed common basic courses, technological basic courses and specialized courses and have taken part in all kinds of fieldwork, therefore they have grasped the basic theories and skills for a specific job or position or specialty.

In order to improve students' ability in combining theory with practice, we formulated a flowchart of industry partnership for graduation design as follows:

1. Mobilization meeting for industry partnership for the graduation stage

   Time: in the beginning of the fifth semester.

   Participators: College president in charge of teaching affairs and director of specialized teaching and research offices.

2. Consulting about industry partnership for the graduation stage.

   Time: in the middle of the fifth semester.

   Participators: Director of specialized teaching and research office and tutors of graduation work.

3. Projects of graduation design. The students have to find projects for their graduation designs and the teachers will contact the enterprises about such projects.

   Time: by the end of the fifth semester.

   Participators: Students and tutors.

4. Evaluation of the projects.

   Participators: Tutors of graduation design.

5. The teachers shall determine the content for graduation design on the basis of their engagements in scientific research or in their cooperation with school factories.

   Time: by the end of the fifth semester.

   Participators: Directors of specialized teaching and research office, tutors and college leaders in charge of the matter.

6. Determining the projects of graduation work and completing relevant tables and documents for instruction and other arrangements.

   Time: 1st week of the sixth semester.

   Participators: Students, tutors, director of teaching and research office and leader in charge of the matter.

7. Working out reports about the projects, literature and pedagogical materials related to the projects.

   Time: By the end of the 3rd week of the sixth semester.

   Participators: Students, enterprise and school tutors.

8. Working in enterprises and starting the graduation work under the instruction of enterprise tutors.

   Participators: Students, enterprise and school tutors.

9. Supervision and management by school tutors.

   Time: Not later than one week before the oral graduation examination.

   Participators: Students, enterprise and school tutors, and members of the oral examination group.

10. Graduation paper writing.

    Time: The last week.

    Participators: students, enterprises and school tutors.

11. Graduation work reporting, oral examination.

Participators: Enterprises and school tutors, and members of the oral examination group.

12. Grading.

Explanation about the flowchart:

1. Mobilization meeting for industry partnership for the graduation stage. The president-in-charge will give introductions about the forms, requirements and problems for attention in the graduation design with typical examples in previous years. Some enterprises will be invited to take part in the meeting. The students are required to strengthen contact with enterprises. They shall actively look for projects, solve all kinds of technical problems for enterprises, and participate in the product design and technical upgrading in those enterprises, thus making their contribution to the development of enterprises. To apply what they learn into their practical work can train them to improve their comprehensive quality. Through their efforts in looking for projects, the students can have a better understanding of enterprises and the industries to be engaged in. To take part in works in enterprises is the first step for them to enter into the society and is a preparation for their future employment. The president hopes that all of them can devote themselves to their works in enterprises.

2. Teachers of specialized teaching and research offices will push the students to take part in industry partnership, provide consulting services for them, offer suggestions and instructions to them, encourage them for their good ideas and correct the defects in their ideas.

   Our experiences show that teachers' continuous push is necessary in this period, for some students will be discouraged when they are refused by some enterprises, some are not brave enough to look for projects for themselves. We hold that students can have a better understanding of the society and promote for themselves in the process of looking for a project with their own efforts, which is the first step for them to enter into the society.

3. After a period of hard work, the students will finally be accepted in succession to work in some enterprises where they can be familiar with their projects, about the progress of which they shall make regular reports to their tutors. The tutors will help them to analyze the feasibility of working on such projects and make arrangements for technical preparation. Meanwhile the teachers will find other projects in some enterprises through certain channels, from which they can select projects for graduation work. The projects that the teachers find are mainly for preparation for the graduation work, and are usually announced to the students in the end of the fifth semester. The students can make their own choice with consideration of their interests and other factors.

   Our experiences tell us that not all the projects from enterprises are suitable for the students to work on and the projects are not enough for every student to have a project. So it is necessary for the teachers to select some suitable one from their own projects, or find some in the course of their contact with enterprises and make appropriate arrangements on the basis of each student's strong suit and the content of each project. In this way the graduation work will be able to carry out in an well-ordered manner.

4&5. Evaluation of the projects. Directors of specialized teaching and research offices and tutors will discuss and evaluate students' projects in terms of their types, difficulties and effectiveness before making final decisions. The projects will be classified as projects for graduation work, for technical preparation, for sub-projects and projects not suitable for graduation work. The decisions will be reported to the college for approval.

6. Relevant tables and documents for instruction and other arrangements shall be completed after the projects are approved by the college. The content of projects, goals and students' major work, detailed work arrangements, means and methods for examination and for

guaranteeing the quality of graduation work are initially determined.

7. Working out reports about their projects (gathering of literature and information related to the projects). The students shall get familiar with their projects' contents and requirements, draft up plans for the graduation work, sort out and gather materials related to their projects and work out reports about their projects. All these shall be finished in two weeks or in a shorter period when the students have made sufficient preparation.

8&9. According to regulations by the college, the enterprises which accept the students to work there on their graduation design are asked to appoint a tutor who is engaged in product development, management of production and technology with a professional title of engineer or higher. During their working in the enterprises, the students will work on their graduation project under the instructions of their enterprise tutors. The school tutors shall make necessary and timely contact with the enterprise tutors for information on the students' work and life and provide consulting services for the students. The students shall report to their school tutors about their progress in the enterprises, once a week in person for those who work in local enterprises, or once every ten days by writing or phone call for those who work in other places, so that the school tutors can check on their work and push them.

In order to find out students' progress in their work and their conduct in the enterprises and to guarantee the quality of graduation work, the college encourages and organizes relevant teachers and members of specialized teaching and research offices to go deep into the enterprises, which helps them to get information on the students' work and on the enterprises so as to set up or strengthen relationships with enterprises.

10. Writing graduation paper or design report. After they complete all the requirements about their graduation projects and have the approval from their tutors, the students can begin to write the graduation paper or design report. The paper or report is one of the main indexes to evaluate the students' achievements, so the students shall work hard not only to present a well-written paper or report which provides sufficient evidences and precise analysis to support the ideas, but also to submit installations for the project, photos evidencing the technical upgrading, the device itself and primary data and evaluations on the device's practicality, reliability, expected social and economic results.

11. Oral graduation examination. Strict examination procedures and systems are guarantees for teaching quality in the graduation stage. The industry partnership enables the students to make full play of their initiatives and to plunge themselves into their projects. The enterprise tutors are asked to take part in the students' oral graduation examination and offer their comments in written forms. The students are required to present their installations or pictures of such installations and to report about the effect and operation of such installations.

12. Grading. In grading, we put more emphasis on students' skills in practical work, the actual results of the projects and the evaluation given by the enterprises than their theoretical level because of the characteristics of vocational education.

COMPARISONS WITH ORDINARY ENGINEERING MAJORS IN THE GRADUATION STAGE

1. For higher vocational education, the goal of industry partnership for graduation stage is to enable the students to be familiar with and adapt to the practical works in modern enterprises. The students are supposed to work on the production front, to engage in and solve all kinds of technical problems arising in production. Their graduation works are more closely related to industrial production than that of ordinary engineering majors.

2. Industry partnership requires the students to be on the spot so that they can learn from the technicians and set out to work under their instruction. Through working on projects closely related to production, the students are able to adapt themselves to the work method of modern enterprises and improve their abilities in analyzing and solving problems. However, ordinary engineering majors usually finish their graduation design and paper in laboratories through means of theoretical analysis, simulation and emulation, so the training of practical work ability tends to be ignored.

3. Vocational students taking part in industry partnership focus on product design, equipment and technical grading and application of matured technology while ordinary engineering majors pay more attention to the application of new technology, development of new products and new technologies. The former serve for front production and the latter for technical reparation and progress.

4. The industry partnership for the graduation stage requires more of a teacher who is supposed to be familiar with production and to know everything about product design, equipment and technical process in addition to theories. However, teachers of ordinary higher education are usually more suitable to work in the field of development and application of new technology, serving for technical progress and preparation.

5. Difficulties in choosing graduation projects. Students taking part in industry partnership for the graduation stage are required to look for projects for themselves, so it is quite normal that not all the projects they find are suitable for them to work on as graduation projects. Some of the projects are from enterprises located far away from the school, making it difficult for the students to go between the enterprise and the school. Some of the students would like to finish their projects independently and refuse to cooperate with other students. All these create difficulties for every student to have a project.

6. Difficulties in management. Our three years' experiences in industry partnership show that industry partnership brings up many difficulties in management though students have more opportunities to choose projects. Some of the students may have been engaged in works dealing with the graduation projects months ahead of schedule while others may not be able to find one when the scheduled graduation design is about to begin.

REWARDS FROM INDUSTRY PARTNERSHIP FOR GRADUATION STAGE

1. The industry partnership for the graduation stage enables the students to make full play of their initiatives. In the practical work environment, the students are able to improve their social ability and work ability, thus making effective and adequate preparations for future employment.

2. The industry partnership helps check the students on their grasp of theory and skill, and improves their ability in applying the theories into practice and in work skills.

3. The industry partnership strengthens the association between the school and enterprises, especially when the students win the commendation from the enterprises with their achievements. By means of industry partnership, the enterprises have a better understanding of students, thus laying a foundation for the students' future employment.

Through three-years' practice, we find that industry partnership for graduation stage of higher vocational education is practicable and therefore shall be popularized. The industry partnership not only conforms to the objectives of higher vocational education, but also helps improve students' ability in practical work, in applying theories , in social work and

in preparing for future employment in an efficient way.

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